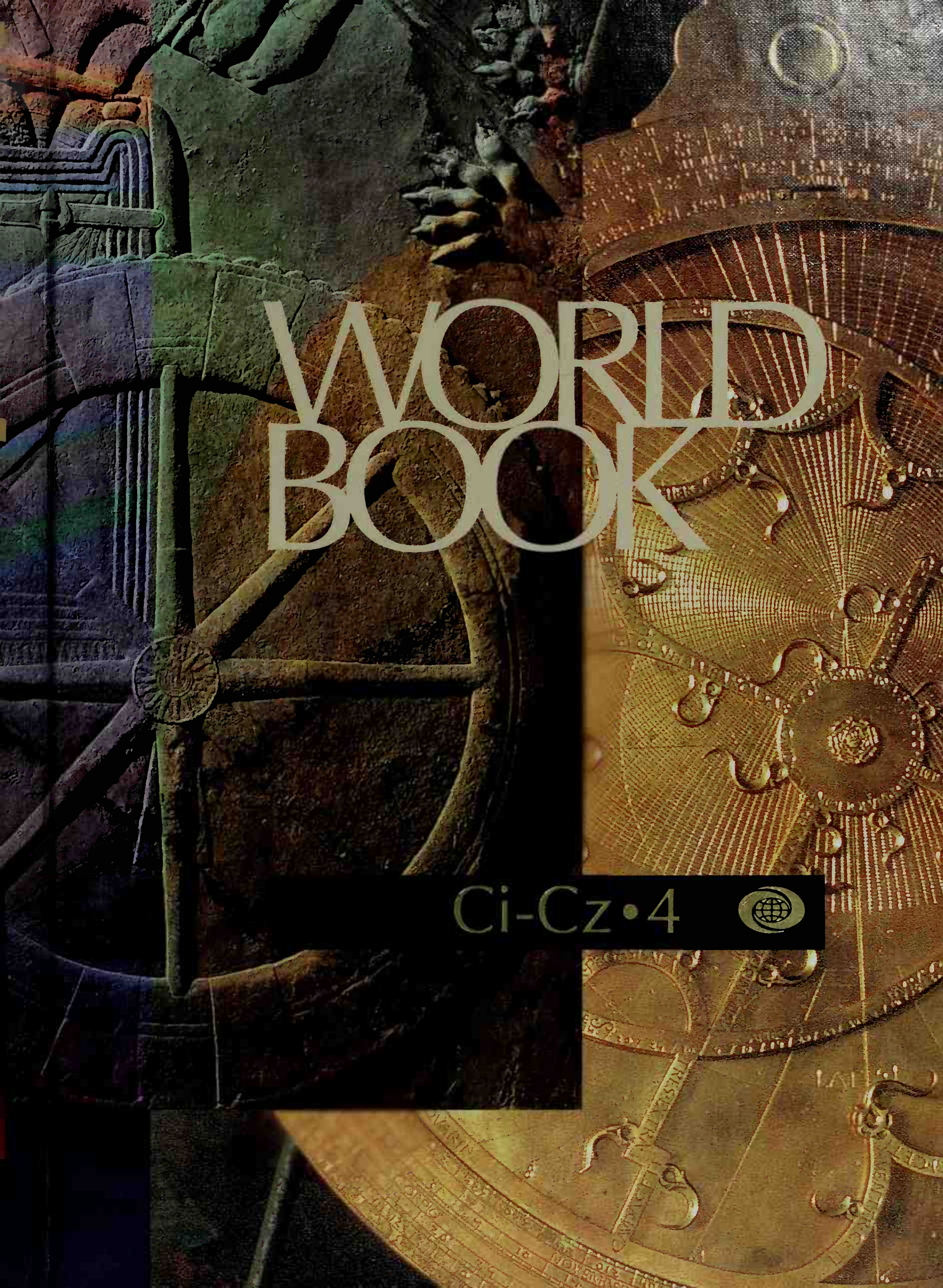
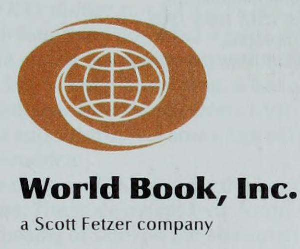

WORLD BOOK
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CIA. See Central Intelligence Agency.

Ciardi, *chee AHR dee,* **John** (1916-1986), was an American poet. Unlike the work of many modern poets, Ciardi's poetry usually is not difficult or surprising. Critics have praised his verse for its musical grace and ease. According to Ciardi, style should serve the purposes of the subject rather than express the individuality of the writer. Critics sometimes accused him of sentimentality, but he achieved the highest excellence in many of his poems and in his translations of Dante's *Divine Comedy* (*Inferno,* 1954; *Purgatorio,* 1961; *Paradiso,* 1970). Collections of Ciardi's poetry appear in *As If: Poems New and Selected* (1955) and *For Instance* (1979).


AP/Wide World
John Ciardi

Ciardi was born in Boston. He taught at Harvard University from 1946 to 1953, and at Rutgers University from 1953 to 1961. He served as poetry editor for *Saturday Review* from 1956 to 1977. Ciardi has written several children's books. He also wrote *How Does a Poem Mean?* (1960), a critical introduction to the study of poetry at the college level. Bonnie Costello

Cíbola, *SEE boh lah,* **Seven Cities of,** were seven legendary cities in what is now the Southwestern United States. Early Spanish explorers in Mexico believed they were rich in gold, silver, and precious jewels.

During the 1530's, Indians in northern Mexico told stories to the Spanish explorers about a rich civilization to the north. These stories led to an expedition in 1539 led by Marcos de Niza, a Spanish priest, to explore the land in the north. Niza sent a black guide named Estevanico ahead to seek information from the Indians. They told Estevanico about seven rich cities in a land they called Cíbola. Estevanico reached Hawikuh, the largest of six Zuni villages near what is now Gallup, New Mexico. The Zuni killed him outside Hawikuh.

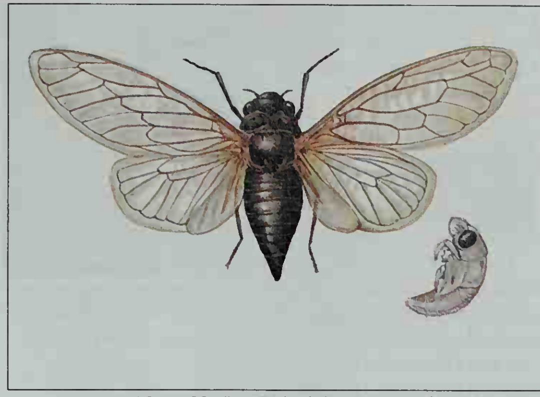
Niza claimed that he saw Hawikuh from a distance and said the village appeared large and wealthy. His report led to an expedition headed by Francisco Vásquez de Coronado in 1540 to conquer the villages and claim their wealth for Spain. Coronado captured the six villages and called them Cíbola. He found no riches there, however, and returned to Mexico in 1542.

Charles Gibson

See also **Coronado, Francisco Vásquez de; Estevanico.**

Cicada, *suh KAY duh* or *suh KAH duh,* is a heavy-bodied insect with four thin wings that it folds over its body like a roof. The cicada is a darkly colored insect from 1 to 2 inches (2.5 to 5 centimeters) long. It has a wide head and short, bristlelike *antennae* (feelers). Most cicadas live in tropical and subtropical areas, but many types live in North America.

Cicadas are commonly known for the buzzing song the male makes. The male makes two drumlike *membranes* (thin sheaths of skin) on the abdomen vibrate rapidly to produce the sound. The sound attracts females or calls large numbers of males together. Each *species* (kind) of cicada has its own song. Many types of male cicadas often assemble in large groups and produce a loud chorus of sounds. Most cicadas produce a short "protest" sound if they are disturbed.


WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited
A cicada emerges as an adult insect after shedding its skin, *right.* The periodical cicada shown above takes 17 years to develop and is often called a *17-year locust.*

Types of cicadas. Two common groups of cicadas are the *dog-day cicadas* and the *periodical cicadas.* Dog-day cicadas are large, very dark, and often have greenish markings. They appear each year in July and August. It takes from four to seven years for a dog-day cicada to develop from an egg into an adult. But some adults are seen each year, because different *broods* (groups of young) develop at different times.

Periodical cicadas are dark, and have red eyes and wing veins. They appear in late May and early June. Periodical cicadas take either 13 years or 17 years to develop, depending on where they live.

Cicadas that take 17 years to develop are sometimes called *17-year locusts.* Adult periodical cicadas thus appear in a region only once every 13 or 17 years. But so many broods exist that they appear somewhere in the United States nearly every year.

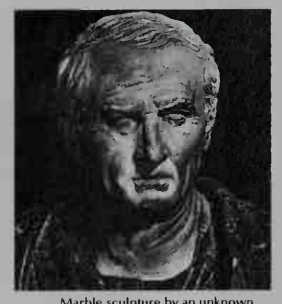
Development. A female cicada lays her eggs in the twigs of trees and shrubs. She places the eggs in small holes that she makes with a sawlike organ near the tip of her abdomen. The twigs usually are so badly injured by the process that the tips of the twigs die. In a few weeks, the eggs hatch and young cicadas called *nymphs* appear. They fall to the ground, enter the soil, and feed on roots. A nymph remains in the ground until it is full-grown. Then it comes out of the ground and climbs a tree or some other object. It sheds its skin, and emerges as an adult. The adult cicada has a life span of only a few weeks. Candace Martinson

Scientific classification. Cicadas belong to the order Hemiptera and the cicada family, Cicadidae. The most common dog-day cicadas belong to the genus *Tibicen.* The periodical cicadas belong to the genus *Magicicada.*

Cicely. See Sweet cicely.

Cicero, *SIHS uh ROH,* **Marcus Tullius,** *TUHL ee uhs* (106-43 B.C.), was a great Roman orator and statesman. His written orations and philosophical and religious essays made him one of the most influential authors in

Latin literature. In his writings, Cicero translated ideas and technical terms into Latin that had previously existed only in Greek. Cicero so improved Latin that it served as the international language of intellectual communication for centuries.


Marble sculpture by an unknown Roman artist; Uffizi Gallery, Florence (Alinari from Art Reference Bureau)
Marcus Tullius Cicero

His life. Cicero was born of middle-class parents in Arpinum, Italy. He studied philosophy, rhetoric, and Greek and Latin literature in Rome, Athens, and Rhodes. Cicero gained fame in 70 B.C., when he successfully prosecuted Gaius Verres, a corrupt former governor of Sicily. Cicero's victory in this trial earned him the approval of the Roman aristocracy. With the support of the aristocracy, he attained the position of consul, Rome's highest elected political office, in 63 B.C.

The First Triumvirate of Julius Caesar, Gnaeus Pompey, and Marcus Licinius Crassus banished Cicero from Rome in 58 B.C. because he opposed their rule. Cicero was allowed to return to Rome in 57 B.C. The Second Triumvirate of Octavian (later the Emperor Augustus), Marcus Aemilius Lepidus, and Mark Antony would not tolerate Cicero's opposition. They had him killed.

His works. Cicero composed more than 100 orations. They are known for their precise choice of words; attention to grammatical structures; and skillful use of descriptions, narration, and prose rhythms. Two series of orations reflect Cicero's support for the republican form of government. In 63 B.C., he delivered four speeches against a Roman named Catiline who plotted to overthrow the Roman government. These speeches led to the defeat and death of Catiline and his followers (see **Catiline**). In 44 and 43 B.C., Cicero composed 14 speeches called the *Philippics*. In them, he attacked Mark Antony because he believed Antony intended to rule Rome with absolute power.

Cicero composed two major works on oratory, *Brutus* and *De Oratore*. He described the advantages of a serene old age in *De Senectute,* and he analyzed friendship in *De Amicitia*. Cicero examined ethical behavior in *De Finibus* and the nature of the gods in *De Natura Deorum*. Cicero discussed the attainment of happiness in *Tusculan Disputations* and one's duties in life in *De Officiis*. The influence of the Greek philosopher Plato appears in a book on law called *De Legibus* and a study of various forms of government called *De Republica*. Cicero was also an active letter writer. His correspondence reveals his informal side. Cicero's letters also provide valuable accounts of Roman life. Joseph R. Tebben

See also **Education** (Ancient Roman education); **Oratory; Latin literature** (The age of Cicero).

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Cid, *sihd,* **The** (1043?-1099), also called El Cid, is one of Spain's national heroes. His real name was Rodrigo Díaz de Vivar. *The Cid* comes from the Arabic *El Sayyid,* meaning *the lord*. The Cid served in the armies of Sancho II and Alfonso VI of Castile. Alfonso banished The Cid in 1081 after The Cid was unjustly accused of disloyalty. The Cid then gathered a small army and fought for anyone who hired him. He was successful in war and gained great power and wealth. In 1094, he conquered Valencia from the Moors, who had controlled much of Spain since the 700's.

The Cid's story became a legend in *Poem of the Cid,* written in the 1100's or early 1200's, and in many later ballads. His story inspired a drama by the French playwright Pierre Corneille. The Cid was born near Burgos and is buried there. James W. Brodman

See also **Spanish literature** (The Middle Ages).

Cider is a beverage made from the juice pressed out of apples. There are two kinds of cider—hard cider and sweet cider. *Hard cider* is an alcoholic drink. Most hard ciders contain 5 to 7 percent alcohol. *Sweet cider* is nonalcoholic apple juice.

Cider is produced by grinding apples and squeezing out the juice with mechanical presses. To make hard cider, the juice is then allowed to *ferment*. In this process, the juice is stored until yeasts convert sugar in the juice to alcohol. Sweet cider is made from juice that is not allowed to ferment. To prevent spoiling, manufacturers pasteurize some hard cider and all sweet cider, and sometimes add chemical preservatives. Hard cider may be made into *cider vinegar* by allowing bacteria to convert the alcohol to *acetic acid*. This acid gives the vinegar its sour taste. See **Vinegar**. Henry P. Fleming

Cigar is a tight roll of dried tobacco used for smoking. Cigars range in size and shape from short, slim *cigarillos* to long, slender *panetelas* and large, fat *coronas*. The majority of cigars are made by machines, but the more expensive ones are hand-rolled.

Most cigars consist of three parts and three types of tobaccos. Folded *filler tobacco leaves* make up most of the body of a cigar. The filler is held together and surrounded by a *binder leaf*. A *wrapper leaf* is wound around the binder. Some inexpensive cigars have as their binders or wrappers *reconstituted tobacco sheets*. These sheets are made of coarse or damaged tobacco leaves that have been ground up and mixed with adhesive. J. H. Smiley

See also **Cuba** (picture); **Smoking; Tobacco**.

Cigarette is a roll of shredded tobacco wrapped in paper. Nearly all cigarettes smoked in the United States are a blend of tobaccos grown inside the country or imported. They contain chiefly flue-cured tobacco, which is grown in Florida, Georgia, North Carolina, South Carolina, and Virginia; burley tobacco, which is grown mainly in Kentucky and Tennessee; imported oriental tobacco, which mostly is grown in Greece and Turkey; and a small amount of Maryland tobacco. Some cigarettes contain flue-cured and burley tobaccos imported from Argentina, Brazil, Canada, and Malawi. They may also contain reconstituted sheet tobacco, which is made from ground leaf stems and leaf pieces. The tobacco blend is sprayed with flavorings and a chemical that preserves moisture. Most cigarettes have a filter at one end.

Hand-rolled cigarettes achieved limited popularity in

the United States between 1855 and 1885. Most smokers rolled their own, but some cigarettes were hand-rolled in factories. Hand-rolled cigarettes contained either Oriental tobacco, flue-cured tobacco, or a blend of the two varieties.

An American inventor named James A. Bonsack patented the first practical cigarette-making machine in 1880. After the invention of cigarette-making machinery, the cigarette industry grew rapidly.

During the 1960's, scientists reported that *tar* and *nicotine,* substances that are inhaled in cigarette smoke, could cause lung cancer, heart disease, and other illnesses. Since then, some countries have passed laws requiring manufacturers to label packages and cartons of cigarettes with a health warning. Some countries have also banned certain types of cigarette advertising and have restricted smoking in public places. Many lawsuits have been brought against cigarette makers because of the health hazards of cigarette smoke. For more information, see **Smoking** (Smoking regulations).

W. David Smith

See also **Cancer** (Genes damaged by substances in the environment); **Filter; Nicotine; Tobacco.**

Cilia, *SIHL ee uh,* are tiny, hairlike structures that project from certain kinds of cells. Cilia are slender and move constantly. They can be seen only under a microscope. In higher animals, cilia are found in cells of the membranes of the nose, the ear, and the tubes leading toward the lungs. The wavy motion of the cilia in these organs pushes out dust, bacteria, and mucus, and keeps the passages clean. In a clam, cilia-containing cells fan water containing food and oxygen into the animal. Many one-celled organisms have cilia that serve as sense organs and provide a means of locomotion.

Lawrence C. Wit

See also **Protozoan** (Ciliates).

Cimabue, *CHEE mah BOO eh,* **Giovanni** (1240?-1302?), an Italian painter, was the first famous painter of the city of Florence. He began an era of famous Florentine painters that included Leonardo da Vinci.

Cimabue's art does not show obvious originality. He painted in a traditional style based on the medieval art of the Byzantine Empire, and his paintings show little of the realism used by the later Florentine painters. His faces and figures are the formalized types of the Byzantine period. But his works have great personal force and effect, even though the forms are traditional.

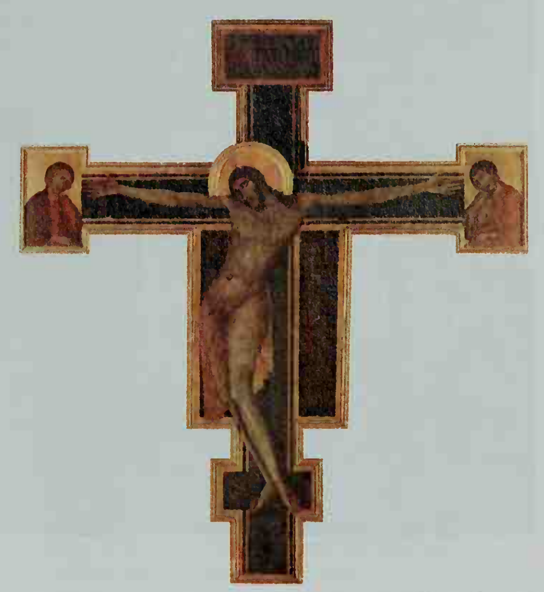
Five or six of Cimabue's works exist today. The most famous include the altarpiece of the *Madonna and Child with Angels* in the Uffizi Gallery in Florence and religious frescoes in the church of Saint Francis at Assisi. Cimabue's church frescoes show great power and grandeur. His *Crucifixion* in the church combines those qualities with dramatic impact. Donald Rabiner

See also **Renaissance** (picture: Medieval and Renaissance art).

Cimmerians were nomads who lived in what is now southern Ukraine from about 1200 B.C. to 700 B.C. They inhabited an area north of the Caucasus Mountains, near the Black Sea. They used horses and the bow and arrow and were known as fierce warriors. They were one of the first nomadic groups to invade Asia Minor (now Turkey) from the north.

Scholars have not found written records left by the Cimmerians and know little about the group. The Greek historian Herodotus wrote that they were driven from their homeland into Asia Minor by nomads called the Scythians. About 700 B.C., the Cimmerians fought the Assyrians and destroyed the kingdom of Phrygia in what is now central Turkey. About 690 B.C., they began to raid Lydia, in what is now western Turkey. The Cimmerians were defeated by the Assyrians during the mid-600's B.C.

Andrew C. Hess



Tempera on wood (1295?); formerly in the Church of Santa Croce, Florence, now in the Uffizi Gallery, Florence (Art Reference Bureau)

Cimabue's *Crucifixion* shows the influence of Byzantine art. A 1966 flood in Florence, Italy, badly damaged the painting.

Cimon, *KY mohn* or *SY muhn* (507?-450 or 449 B.C.), was a military and political leader in ancient Athens. In 478 and 477 B.C., he helped form the Delian League of Greek city-states to wage war against Persia. During most of the 470's and 460's B.C., Cimon commanded the league's Athenian forces. Cimon also led the aristocrats in Athens.

In 461 B.C., a quarrel between Athens and Sparta led democratic leaders in Athens to banish Cimon because he favored friendly relations with the Spartans. Cimon probably returned to Athens in 451 B.C. That year, he arranged a truce between the two city-states.

Jennifer Tolbert Roberts

Cinchona, *sihn KOH nuh,* is the name of a group of valuable South American trees and shrubs. The bark of a cinchona is called *Jesuits' bark, cardinal's bark,* or *sacred bark.* The bark is used to make the drugs quinine, quinidine, and cinchonidine, with which doctors treat malaria. The cinchona is an evergreen. Cinchona plants were first found in Peru and Ecuador. They are now grown in India, Sri Lanka, eastern and southeastern Asia, tropical America, and parts of Africa. The flowers are usually fragrant. They vary from rose-purple to greenish-white and look like lilac blossoms. Frank Welsch

Scientific classification. Cinchona belongs to the madder family, Rubiaceae. Cinchona makes up the genus *Cinchona.*

See also **Bitters; Quinine.**



© Corbis

Cincinnati is a center of industry and commerce in the Midwestern United States. The city lies on the Ohio River in southwestern Ohio. Bridges across the Ohio River connect Cincinnati with the state of Kentucky.

Cincinnati, *SIHN suh NAT ee,* is a major industrial and commercial center of the Midwest. It is one of the largest cities in Ohio. Cincinnati lies on the Ohio River in the southwestern part of the state. It is one of the most beautiful cities in the nation and was once called the *Queen City of the West.*

In 1788, settlers established a village called Losantiville on what is now the site of Cincinnati. In 1790, General Arthur St. Clair, the first governor of the Northwest Territory, changed the name to Cincinnati. He did so to honor the Society of the Cincinnati, an organization that was formed by Army officers of the Revolutionary War in America (see **Cincinnati, Society of the**).

River trade accounted for much of Cincinnati's growth during the 1800's. Steamboats linked the city with many major ports. Later, after railroads became the chief method of transportation, Cincinnati lost much trade to other cities. Today, Cincinnati's economy relies on many kinds of manufacturing and service industries.

Metropolitan Cincinnati

Cincinnati lies on the north bank of the Ohio River. The Great Miami and the Little Miami rivers flow into the Ohio on two sides of the city. Cincinnati covers 79 square miles (205 square kilometers), or about a fifth of Hamilton County. The Cincinnati metropolitan area occupies 3,342 square miles (8,656 square kilometers) and extends over Hamilton, Brown, Clermont, and Warren counties in Ohio; Boone, Campbell, Gallatin, Grant, Kenton, and Pendleton counties in Kentucky; and Dearborn and Ohio counties in Indiana.

The city. A flat plain called the *basin* extends north into Cincinnati from the Ohio riverfront. In this area are the city's central business district, some manufacturing sections, and several old residential areas. Hills surround the basin on three sides.

Downtown Cincinnati centers around Fountain Square Plaza, between Vine and Walnut streets. The 48-story Carew Tower, the city's tallest building, rises west of the square. Fourth Street, the heart of Cincinnati's financial district, lies south of the square. A convention center stands at the western edge of the business district. In 1986, the city completed an expansion of the convention center. The expanded facility was named the Albert B. Sabin Cincinnati Convention Center in honor of the doctor who developed the oral polio vaccine in Cincinnati in the 1950's. The birthplace of United States President William Howard Taft lies north of the business district.

The metropolitan area. Residential areas occupy the hillsides surrounding the basin. Cincinnati suburbs include Madeira, Norwood, and Saint Bernard. The metropolitan areas of Cincinnati and of Hamilton-Middletown, Ohio, form the Cincinnati-Hamilton Consolidated Metropolitan Area.

The people

About 97 percent of Cincinnati's people were born in the United States. Blacks make up about 43 percent of the city's population and about 13 percent of the metropolitan area population. Most blacks live north and east of downtown. But since about 1980, increasing numbers have moved to areas throughout the city and the suburbs. About 15 percent of the people have German ancestry, though the city lacks a strong ethnic identity. Other major groups include people of English, Irish,

Facts in brief

Population: *City*—331,285. *Metropolitan area*—1,646,395. *Consolidated metropolitan area*—1,979,202 (1,556,755 in Ohio, 370,715 in Kentucky, and 51,732 in Indiana).
Area: 79 mi² (205 km²). *Metropolitan area*—3,342 mi² (8,656 km²). *Consolidated metropolitan area*—3,810 mi² (9,868 km²), excluding inland water.
Altitude: 550 ft (168 m) above sea level.
Climate: *Average temperature*—January, 36 °F (2 °C); July, 79 °F (26 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—39 inches (99 centimeters). For the monthly weather in Cincinnati, see **Ohio** (Climate).
Government: Council-manager. *Terms*—2 years for the nine council members; manager appointed.
Founded: 1788. Incorporated as a city in 1819.

and Italian descent. In Cincinnati, poverty is a problem—especially among whites from the Appalachian Mountains and blacks.

Economy

Industry and commerce. The Cincinnati metropolitan area has about 2,300 manufacturing companies. They employ about 140,000 workers and produce goods with a *value added by manufacture* of about $16 billion a year. Value added by manufacture represents the increase in value of raw materials after they become finished products. Cincinnati ranks as the world's leading manufacturer of soap and the nation's chief producer of machine tools and playing cards. Other major Cincinnati industries produce aircraft engines, automobile parts, food products, machinery, chemicals, fabricated metal products, and printed materials.

About 20 percent of the Cincinnati area's workers are employed in manufacturing. About 26 percent of the workers hold jobs in wholesale and retail trade, and 37 percent work in other service industries. More than 800 area companies are involved in international trade.

The Port of Cincinnati handles more than 46 million short tons (42 million metric tons) of cargo annually. Thirty-six barge lines operate on the Ohio River.

Transportation. Cincinnati links Ohio and the other north-central states with the South. Railroad passenger trains and rail freight lines serve the city. Several major highways, including three interstate routes, pass through Cincinnati.

Numerous commercial airlines take off and land at the Cincinnati/Northern Kentucky International Airport, which lies 12 miles (19 kilometers) outside the city in Boone County, Kentucky. The steamboats *Delta Queen* and *Mississippi Queen* provide service between Cincinnati and other Ohio and Mississippi river ports.

Communication. Cincinnati has two daily newspapers, *The Cincinnati Enquirer* and *The Cincinnati Post.* More than 40 suburban newspapers also serve the Cincinnati metropolitan area. The city has 9 television stations and 27 radio stations.

Education

The Cincinnati public school system includes about 100 elementary and high schools, with a total of about 50,000 students. Many of the schools are *magnet schools* that offer special training in a particular field, such as the visual and performing arts or foreign languages. Blacks make up about 55 percent of the public school enrollment. The metropolitan area also includes about 100 other public and private school systems.

The University of Cincinnati was founded in 1819. Other schools in the area include Cincinnati Technical College; College of Mount St. Joseph; the Hebrew Union College—Jewish Institute of Religion, the oldest Jewish theological school in the United States; Miami University; Northern Kentucky University; Thomas More College; and Xavier University. The Public Library of Cincinnati and Hamilton County has 42 branches.

Cultural life

The arts. The Cincinnati Symphony Orchestra and the Cincinnati Opera perform at the Cincinnati Music Hall. The Cincinnati Ballet performs at the Stanley J. Aronoff Center for the Arts. Cincinnati's annual May festival, first held in 1873, is the oldest choral festival in the nation. Cincinnati also has two professional theater companies. These are the Cincinnati Playhouse in the Park, which performs in Eden Park, and the Ensemble Theatre Company.

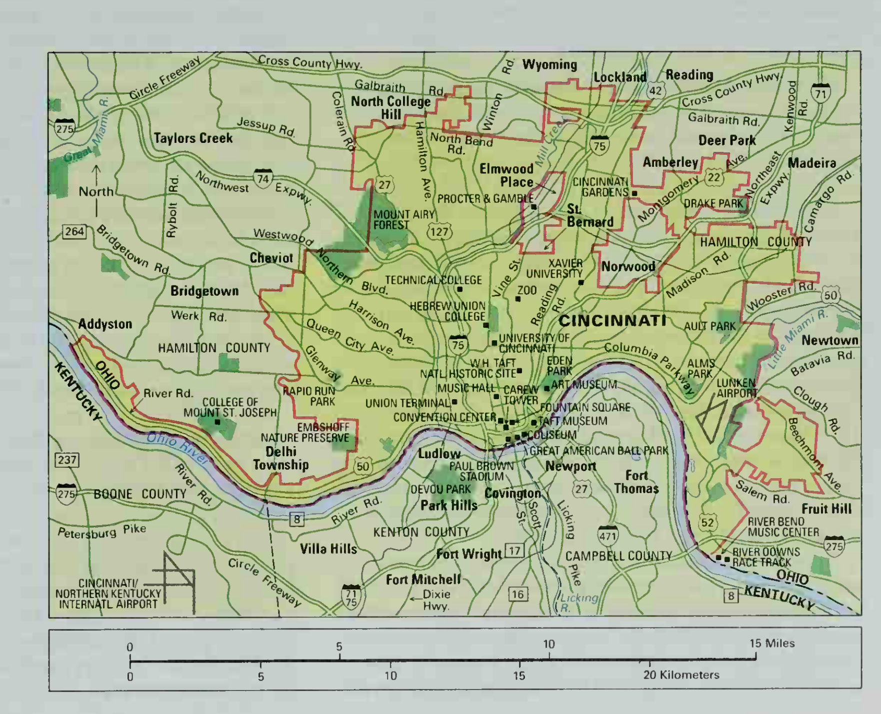
Museums. The Cincinnati Art Museum, in Eden Park, has more than 100 galleries of famous art works, includ-

City of Cincinnati



Cincinnati is a leading Midwest commercial center. The map shows the city, located on the Ohio River, and its main points of interest.

- City boundary
- County boundary
- State boundary
- Expressway
- Other road
- Railroad
- Point of interest
- Park



WORLD BOOK map

ing collections representing ancient civilizations. The Taft Museum features English, Flemish, and French paintings. The Contemporary Arts Center showcases works of artists from the late 1900's to the present. The Museum Center complex at Cincinnati Union Terminal train station houses several cultural attractions. These attractions include the Cincinnati Museum of Natural History; the Cincinnati Historical Society; and a children's science museum.

Recreation

The Ohio River provides a setting for many recreational areas in the Cincinnati area. During the summer, excursion boats operate on the river. Many people also enjoy the several artificially created lakes near the city.

Parks and playgrounds in the area cover about 5,000 acres (2,000 hectares). Mount Airy Forest, the largest park, has about 1,500 acres (607 hectares) of camping grounds, picnic areas, and woods. Eden Park includes the Krohn Conservatory, which is famous for its tropical and seasonal plant displays. Ault Park hosts the Cincinnati Flower Show. The Cincinnati Zoo and Botanical Gardens houses one of the nation's largest collections of animals. It has earned an international reputation for its breeding programs for endangered animals.

Sports. The Cincinnati Reds of the National League play baseball in the city. The team was the nation's first professional baseball team. The city is also the home of the Cincinnati Bengals of the National Football League.

Government

Cincinnati has a mayor-council form of government. Voters elect the mayor to a four-year term. The nine council members are elected to two-year terms. The mayor hires a city manager with the advice and consent of the council. Cincinnati gets most of its revenue from a payroll tax.

History

Early days. The powerful Miami Indians once hunted in what is now the Cincinnati area. In 1788, settlers arrived there and founded a village called Losantiville. In 1790, General Arthur St. Clair, governor of the Northwest Territory, renamed the settlement Cincinnati.

Many settlers came to the village during the late 1700's. They opened new businesses or set up farms in the surrounding area. Cincinnati was incorporated as a town in 1802. By 1810, it had more than 2,500 people.

The 1800's. Much of the town's growth during the early 1800's resulted from river trade. Steamboat service, which began on the Ohio River in 1811, permitted goods to be transported quickly and inexpensively. Cincinnati soon became an important river port and, in 1819, received a city charter. In 1827, workers completed the first section of the Miami and Erie Canal. This canal, which connects Cincinnati with northern Ohio communities, greatly increased local trade. By 1830, the city's population had risen to nearly 25,000.

During the 1830's and 1840's, thousands of Germans left their country and settled in Cincinnati. A large German-speaking community, known as the *Over-the-Rhine* area, grew up north of the business district. Germans contributed greatly to the cultural and economic development of the city. In the 1840's, many Irish immigrants came to Cincinnati after fleeing a potato famine in their homeland.

A number of slaughterhouses and pork-packing plants opened in Cincinnati during the 1830's and 1840's. Farmers sent their livestock, especially hogs, to be processed in the city. The meat was then shipped down the Ohio River to other ports. By 1850, Cincinnati had become the nation's chief pork-packing center.

During the mid-1800's, Cincinnati became an important point on the underground railroad, which helped runaway slaves escape to the North. Harriet Beecher Stowe gathered much material in Cincinnati for her famous antislavery novel, *Uncle Tom's Cabin.* Trade between Cincinnati and the South ended during the American Civil War (1861-1865). But several merchants made up their losses by starting arms and ammunition factories and selling their products to the government.

After the Civil War, trade expanded from Cincinnati into the Southwest, and the city's river traffic increased. The Art Museum, Fountain Square, and the Music Hall were built. Cincinnati also annexed more than 20 neighboring communities during the 1860's. By 1870, the population of the city had reached about 216,000.

Cincinnati's position as an important commercial center declined during the 1870's. River trade dropped because railroads were carrying more and more freight to Chicago and other cities. Cincinnati revived its Southern markets in 1880, when the Cincinnati Southern Railway, built by the city, reached Chattanooga.

During the late 1800's, manufacturing became one of the city's main sources of income. With the growth of Procter & Gamble and other soap companies, Cincinnati's population rose to more than 325,000 by 1900.

The 1900's. During the early 1900's, many wealthy Cincinnati residents moved from the basin area to the surrounding hillsides. The riverfront became the site of factories, railroads, and shipping facilities, and the houses near the river turned into slum dwellings.

World War II (1939-1945) brought defense industries to the area. Great numbers of rural people moved to the city to take factory jobs. Most of these workers remained after the war, and the government built many low-rent apartment projects to house them. The government also rebuilt parts of the riverfront district.

Cincinnati experienced a population shift to the suburbs in the late 1900's, but its neighborhoods remained lively, and its downtown continued to grow. Many new office towers, department stores, shops, and hotels were constructed in the downtown area.

Recent developments. In 2000, a new football stadium was completed on the riverfront. Construction began nearby on a new baseball stadium.

Kerry Klumpe

Cincinnati, Society of the, is an organization of men descended from commissioned officers who served in the Continental Army or Navy during the Revolutionary War in America (1775-1783). Continental Army officers founded it in 1783. George Washington was its first president-general. The name *Cincinnati* comes from Lucius Quinctius Cincinnatus, a Roman statesman and general who was a legendary model of patriotism. General Arthur St. Clair, a member and the first governor of the Northwest Territory, named the city of Cincinnati, Ohio, for the society.

Today, the Society of the Cincinnati has about 3,500 members in the United States and France. Headquarters are in Washington, D.C. The society operates a museum and reference library relating to the Revolutionary War at the headquarters.

Critically reviewed by the Society of the Cincinnati

Cincinnatus, *SIHN suh NAY tuhs,* **Lucius Quinctius,** *LOO shuhs KWIHNGK tee uhs* (519?-439? B.C.), a Roman statesman and general, was a legendary model of patriotism. In 458 B.C., Rome was threatened by the Aequi, a tribe of central Italy. The Senate sent messengers to tell Cincinnatus that he had been named commander in chief. The messengers found him plowing his fields. He joined the army at once, and marched to rescue a *consul* (chief government official) who was in great danger. Cincinnatus defeated the enemy, marched his army back to Rome, and resigned. He returned to his farm 16 days after he took office.

George Washington was sometimes called the "American Cincinnatus" because he also held his office only as long as necessary. After the Revolutionary War in America (1775-1783), a group of former officers formed the patriotic Society of the Cincinnati. The city of Cincinnati, Ohio, is named after this organization. Arther Ferrill

Cinco de Mayo, *SEENG koh duh MAH yoh,* is a holiday celebrated on May 5 by Mexicans and Mexican Americans. Its name is Spanish for *Fifth of May.*

Cinco de Mayo commemorates the victory of a Mexican army over a French army at the Battle of Puebla on May 5, 1862. The Mexican army, led by General Ignacio Zaragoza, won the battle even though the French force was better armed and three times as large. The battle occurred after Emperor Napoleon III of France sent troops to Mexico to conquer the country. Despite the Mexican victory at Puebla, the French later gained control of Mexico City and established a French-supported government there. In 1866 and 1867, however, France withdrew its troops from Mexico because of resistance by many Mexicans and pressure from the United States. The French-backed government soon fell.

Cinco de Mayo is celebrated differently in different areas. Some Mexican towns hold small celebrations that include parades, town meetings, or speeches. In the United States, celebrations often include parades, folk dancing, speeches, carnival rides, and Mexican music.

Homer D. C. Garcia

Cinema. See **Motion picture.**

Cineraria, *SIHN uh RAIR ee uh,* is a group of herbs that belong to the composite family. Cinerarias grow wild in the Canary Islands, but they are cultivated in gardens throughout the world. The flower heads on the plants are usually purple, red, or purple and white, with dark centers.

The plants are easily grown from seed. Cinerarias make fine window plants. However, they must be grown at a temperature less than 65 °F (18 °C).

David J. Keil



WORLD BOOK illustration by Robert Hynes

Cineraria blossoms

Scientific classification. Cinerarias belong to the genus *Senecio* in the composite family, Asteraceae or Compositae.

Cinnabar is a bright red mineral consisting of mercury and sulfur. It provides most of the world's supply of mercury. The chemical formula for cinnabar is HgS. Cinnabar crystals are six-sided, either hexagonal or rhombohedral (see **Crystal** [Classifying crystals]). Cinnabar rarely appears as large crystals. However, mines in the Hunan Province of China have produced large, gemlike crystals since the early 1980's. Cinnabar usually occurs in earthy masses or scattered in opal. It is found mostly near the earth's surface, close to volcanic rocks and hot springs. In addition to China, deposits of cinnabar occur in Italy, Slovenia, and Spain; and in California, Nevada, and Oregon. See also **Mercury** (element).

Robert B. Cook

Cinnamon is a popular spice used in cooking and for flavoring candies and preserves. It comes from the inner bark of the cinnamon tree. The tree grows in Sri Lanka, the principal source of the spice, and in Brazil, India, Jamaica, Java, Madagascar, and Martinique. The cinnamon tree grows as high as 30 feet (9 meters) and has oval leaves and tiny yellow flowers. The fruit of the cinnamon tree looks like an acorn.



WORLD BOOK photo

Cinnamon is sold in both powdered and stick form.

Workers cut off the tops of cinnamon trees near the lower buds so that strong, straight shoots grow up from the base. The shoots are gathered, and the inner bark is peeled off. The bark then turns brown and curls up as it dries. The dried bark is sold as stick cinnamon or is ground up to make powdered cinnamon. Oil of cinnamon is made from the fruit, leaves, and roots of the tree.

An oil similar to that of the cinnamon tree comes from a related plant, commonly called cassia. Cassia oil and bark are often used instead of cinnamon. Lyle E. Craker

Scientific classification. The cinnamon tree belongs to the laurel family, Lauraceae. Its scientific name is *Cinnamomum zeylanicum.* The cassia plant is *C. cassia.*

Cinquefoil, *SIHNGK foyl,* is the name of about 500 species of plants that belong to the rose family. Cinquefoils grow wild in most cool and cold regions of the world. Most species are herbs. A few species are erect or creeping shrubs. The leaves of cinquefoils consist of three, five, or more leaflets in a fingerlike or featherlike arrangement. Some species are called *five-finger* because of the shape of their leaves. The blossoms are bright yellow, orange, white, or reddish in color. Some cinquefoils are troublesome weeds. Other types are grown in gardens. See also **Flower** (picture: Flowers of the Arctic tundra). Kenneth R. Robertson

Scientific classification. Cinquefoils belong to the rose family, Rosaceae. They make up the genus *Potentilla.*

CIO. See **Congress of Industrial Organizations.**

Cipher. See **Codes and ciphers.**

Circe, *SUR see,* a beautiful enchantress in Greek mythology, had the power to turn men into beasts. She lived on an island in the Mediterranean Sea. When Odysseus (Ulysses in Latin) landed on her island, Circe

turned most of his men into pigs and drove them into a pigsty. But the god Hermes had given Odysseus a magic herb which protected him from Circe's power (see Hermes; Ulysses). Odysseus forced Circe to give his men their human form again. After that, Circe became friendly. She loved Odysseus and persuaded him to stay with her on the island for a year. When he prepared to leave, she warned him about the dangers that awaited him, and told him how to overcome them. For example, Circe told Odysseus that by plugging his sailors' ears with wax he could safely pass the island where the Sirens lived (see Siren). See also **Odyssey; Scylla.**

Cynthia W. Shelmerdine

Circle is a closed curve on a plane. All points of the curve are the same distance from a point that lies within the curve. This point is called the *center.* There are 360 degrees in a circle.

Many common objects have a circular shape, including rings, hoops, and wheels. You can easily draw a circle with an instrument called a *compass.* A compass looks like a pair of scissors with a pencil where one point should be. To draw a circle, place one point of the compass at the point chosen as the center, and rotate the pencil around it.

Parts of a circle. Sometimes people use the words *disc* or *circle* to mean the area inside the curve. They call the curve itself the *circumference.* The length of the curve is also called the circumference. An *arc* is any connected part of the circumference.

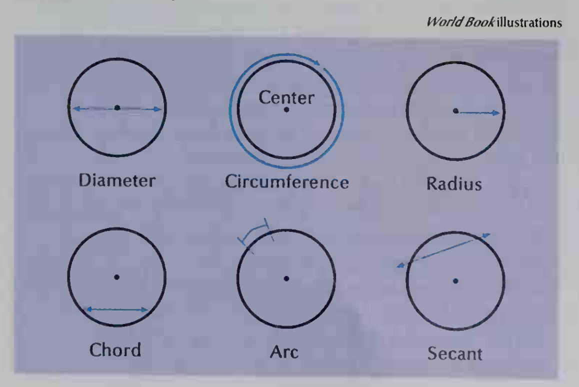
A *chord* is a straight line between two points on the circumference of a circle. If a chord goes through the center, it forms a *diameter.* A diameter is the longest chord of a circle, and divides the circle into two equal parts called *semicircles.*

The *radius* is the distance from the center to the circumference. It equals half the length of a diameter. The word *radius* is also used to mean any line that joins the center to the circumference.

A *secant* is a straight line that intersects a circle at two points. A line that just touches the circle, or meets the circle at just one point, is called a *tangent.* If you move a secant away from the center of the circle so that it always lies parallel to its previous position, the two points at which it touches the circle will get closer to each other. When the points come together, the secant has reached the position of a tangent. The point where the tangent touches the circle is the *point of tangency.* The radius at the point of tangency makes a right angle with the tangent.

Parts of a circle

World Book illustrations



The use of pi. The Greek letter *pi* (written π) stands for the number by which the diameter of a circle (d) must be multiplied to obtain the circumference (c). That is, $c=\pi d$ or $2\pi r$, where r is the radius. The area of a circle (A) is given by the formula $A=\pi r^2$.

You cannot write π exactly as a decimal. But by increasing the number of digits, you can get a number as near to it as you want. Common estimates used for π include $\frac{22}{7}$, 3.14, 3.1416, and 3.14159.

History. The ancient Chinese used 3 as the value of π. About 1650 B.C., the Egyptians improved on the approximation. During the A.D. 100's, the astronomer Ptolemy of Alexandria calculated an even more precise value of π. The decimal system did not come into use until the 1600's, but Ptolemy's value was the equivalent of 3.1416. After the introduction of decimals, mathematicians sought an exact value for π—either a repeating decimal or a value with a limited number of decimal places. Mathematicians now know that there is no such value.

Colin C. Graham

See also **Degree; Pi; Radian.**

Circuit, Electric. See Electric circuit.

Circuit breaker is an automatic switch. It protects electric motors, household wiring, long-distance power lines, and other electric circuits against damage caused by too much electric current. Too much current may flow in a circuit as a result either of a fault in the circuit or of an outside event, such as lightning.

Every circuit breaker is designed to allow a specific maximum amount of electric current to pass. If the current exceeds this limit, an automatic mechanism inside the circuit breaker throws open a *set of contacts* (switch) and stops the current. Mechanisms used to open the switch include electromagnets and temperature-sensitive devices similar to a thermostat. As the switch opens, an electric arc leaps across the open contacts. Electricity continues to flow through this arc until it is extinguished. In an *oil circuit breaker,* the switch is immersed in an oil that extinguishes the electric arc. In an *air-blast circuit breaker,* a blast of compressed air blows out the arc. In a *magnetic arc-suppression circuit breaker,* a magnetic field deflects and breaks the arc.

A circuit breaker called a *ground fault circuit interrupter* (GFCI) helps prevent electric shocks. Most electric shocks occur when people use faulty appliances. Such appliances can produce slight variations in the electric current entering and leaving the circuit. A GFCI detects these changes, which are too small to activate an ordinary circuit breaker. It then automatically shuts off the electricity to the defective appliance.

Some circuit breakers are about as small as an ordinary light switch. But some are as large as a small two-story house. A large circuit breaker can interrupt currents up to 40,000 amperes at 345,000 volts. It can open a circuit in less than $\frac{1}{30}$ of a second, and reclose it in less than $\frac{1}{3}$ of a second. Donald W. Novotny

Circuit rider was an important figure in pioneer times in America. There were two kinds of circuit riders. One was a religious man who rode a *circuit* (regular route) conducting services. The other was a judge who rode a circuit hearing cases. Either kind of circuit might cover great distances.

Preachers, often called *backwoods preachers,* began riding circuits in what is now the United States during the 1760's. John Wesley, founder of the Methodist movement in Great Britain, sent several *lay preachers* (people not ordained as ministers) to preach the gospel in America. Famous early circuit riders included Francis Asbury, one of the first Methodist bishops in the United States, and Peter Cartwright, a pioneer preacher in Kentucky and Illinois.

Judges began riding circuits in 1790. Congress divided the 13 states into three circuits, with two Supreme Court justices appointed to hear cases in each circuit. This system was changed when more states joined the Union and the Supreme Court had more work to do. Many state judges also rode circuits. Lawyers usually traveled with the judges and would argue cases brought to the court. Abraham Lincoln spent several years riding circuits as a lawyer in Illinois. Odie B. Faulk

Related articles in ***World Book*** include:

Asbury, Francis
Lincoln, Abraham (Riding the circuit)
Pioneer life in America (Religion)
Western frontier life (Religion)

Circulation. See Circulatory system.

Circulatory system is a network that carries blood throughout the body. All animals except the simplest kinds have some type of circulatory system.

In some *invertebrates* (animals without a backbone), the circulatory system consists of a simple network of tubes and hollow spaces. Other invertebrates have pumplike structures that send blood through a system of blood vessels. In human beings and other *vertebrates* (animals with a backbone), the circulatory system consists primarily of a pumping organ—the heart—and a network of blood vessels.

The human circulatory system supplies the cells of the body with the food and oxygen they need to survive. At the same time, it carries carbon dioxide and other wastes away from the cells. The circulatory system also helps regulate the temperature of the body and carries substances that protect the body from disease. In addition, the system transports chemical substances called *hormones,* which help regulate the activities of various parts of the body. This article discusses mainly the human circulatory system.

Parts of the circulatory system

The human circulatory system has three main parts: (1) the heart, (2) the blood vessels, and (3) the blood. A watery fluid called *lymph,* and the vessels that carry it, are sometimes considered a part of the circulatory system (see Lymphatic system).

The heart is a hollow, muscular organ that pumps blood. It consists of two pumps that lie side by side. These pumps relax when taking in blood and contract as they send out blood. The left side of the heart is a stronger pump than the right side. The stronger pump receives blood from the lungs and sends it to cells throughout the body. The weaker pump receives blood from the cells throughout the body and sends the blood to the lungs.

The blood vessels form a complicated system of connecting tubes throughout the body. There are three major types of these vessels. *Arteries* carry blood from the heart. *Veins* return blood to the heart. *Capillaries* are extremely tiny vessels that connect the arteries and the veins.

The blood consists chiefly of a liquid called *plasma* and three kinds of solid particles known as *formed elements.* Plasma is made up mostly of water, but it also contains proteins, minerals, and other substances. The three types of formed elements are called *red blood cells, white blood cells,* and *platelets.* Red blood cells carry oxygen and carbon dioxide throughout the body. White blood cells help protect the body from disease. Platelets release substances that enable blood to clot. Platelets thus aid in preventing the loss of blood from injured vessels.

Functions of the circulatory system

The circulatory system performs many vital functions. It plays an important role in respiration. The circulatory system is also important in nutrition, in the removal of wastes and poisons, and in several other body processes.

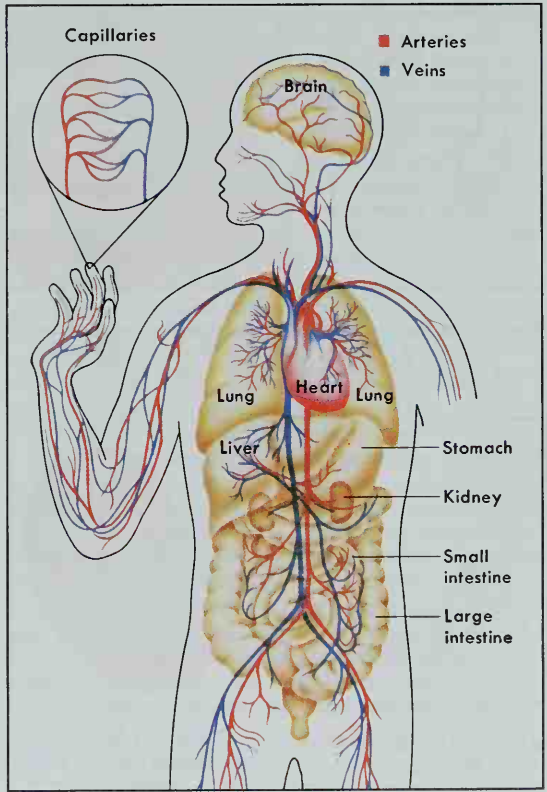
In respiration. The circulatory system plays a part in respiration by delivering oxygen to the cells and removing carbon dioxide from them. During this process, the blood follows two routes called the *systemic circulation* and the *pulmonary circulation.*

From the left side of the heart, blood full of oxygen is

The human circulatory system

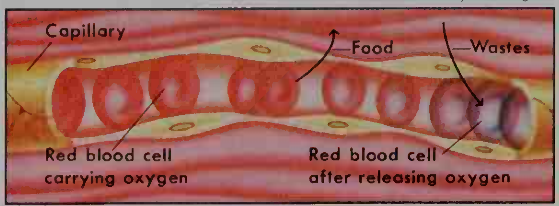
A person's circulatory system consists chiefly of a pump—the heart—and a network of blood vessels. These vessels—arteries, veins, and capillaries—carry blood throughout the body.

WORLD BOOK illustration by Colin Bidgood

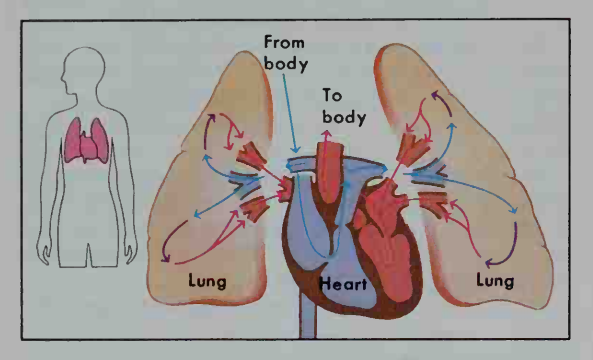


Some functions of the circulatory system

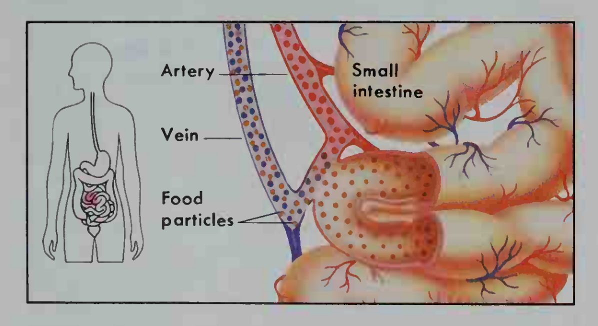
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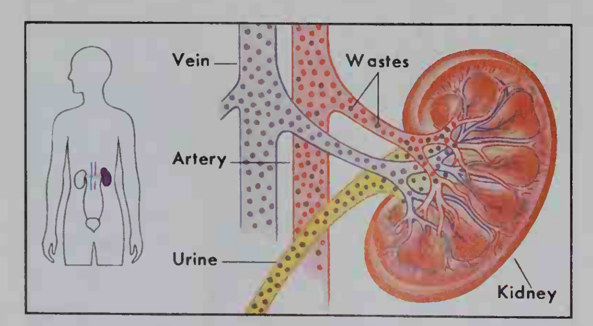
In maintaining body tissues. The circulatory system supplies tissues of the body with essential food and oxygen, and carries away carbon dioxide and other wastes. Substances leave and enter the bloodstream through thin capillary walls.



In respiration. Blood carrying carbon dioxide, *blue,* flows to the heart. The heart pumps it to the lungs, where it gives up carbon dioxide and picks up oxygen. The oxygen-rich blood, *red,* returns to the heart and is pumped to all parts of the body.



In nutrition. The circulatory system carries digested food particles to the cells of the body. These particles enter the bloodstream through the walls of the small intestine.



In removal of wastes. Waste products from body tissues are carried by the blood to the kidneys. The kidneys filter out these substances and expel them in the urine.

pumped into the systemic circulation. This blood leaves the heart through the *aorta,* the main artery of the body. A number of major arteries branch off the aorta. These arteries, in turn, branch into smaller and smaller vessels, finally emptying into the tiny capillaries. There, oxygen leaves the blood and enters the tissues through the thin capillary walls. In a similar way, carbon dioxide leaves the tissues and enters the blood. The blood, now carrying carbon dioxide, leaves the capillaries and flows through larger and larger veins. Eventually, the blood enters the right side of the heart through two large veins—the *superior vena cava,* which carries blood from the head and arms, and the *inferior vena cava,* which carries blood from the trunk and legs.

From the right side of the heart, the blood is pumped into the pulmonary circulation. *Pulmonary arteries* carry the blood that contains carbon dioxide to capillaries in the lungs.The carbon dioxide passes through the capillary walls into the lungs and is then exhaled. Oxygen that has been inhaled passes from the lungs into the blood in a similar way. The blood returns through the *pulmonary veins* to the left side of the heart and begins its journey again.

In nutrition. The circulatory system carries digested food substances to the cells of the body. These nutrients enter the bloodstream by passing through the walls of the small intestine into the capillaries. The blood then carries most of the nutrients to the liver.

The liver removes certain nutrients from the blood and stores them. It later releases the nutrients into the blood when the body needs them. The liver also changes some nutrients into substances needed by the body. Blood leaving the liver contains nutrients that the cells use in the production of energy, enzymes, and new building materials for the body.

In removal of wastes and poisons. The circulatory system helps dispose of waste products and poisons that would harm the body if they accumulated. These substances include carbon dioxide, salts, and *ammonia,* a by-product of the cell's use of protein.

The liver removes ammonia and other wastes, and various poisons that enter the body through the digestive system. The liver converts the wastes and poisons into water-soluble substances, which are carried by the blood to the kidneys. The kidneys filter out these and other water-soluble wastes and expel them from the body in urine.

Other functions. The circulatory system helps protect the body from disease. White blood cells engulf and destroy bacteria, viruses, and other harmful invaders. As the blood circulates, it also helps keep the body temperature stable by absorbing heat from the cells' production of energy.

If the temperature of the body begins to rise, the flow of blood into vessels in the skin increases. The heat from cells deep in the body is thus carried to the skin, from where it passes out of the body. If the temperature of the body begins to drop, the flow of blood to the skin is restricted. This action enables the body to retain as much heat as possible.

The circulatory system also carries hormones. These chemical substances affect or control the activities of various organs and tissues. Hormones are produced by the endocrine glands, including the thyroid, pituitary,

adrenal, and sex glands. These glands release their hormones into the bloodstream.

Disorders of the circulatory system

The circulatory system can be damaged by disease or injury. One of the most common diseases of the system is *arteriosclerosis,* which results from the accumulation of fatty deposits in the arteries. Such deposits stiffen and thicken the walls of the arteries. As a result, the flow of blood is restricted. In some cases, blood clots develop in vessels affected by arteriosclerosis. Such clots may lead to a heart attack or a *stroke,* a condition in which the brain does not receive enough blood.

Another disease, *hypertension,* commonly called *high blood pressure,* is often associated with arteriosclerosis. Hypertension makes the heart work harder and may lead to such complications as a heart attack, a stroke, or kidney failure.

Treatment for arteriosclerosis and hypertension includes rest, exercise, and changes in the diet. Physicians may prescribe various drugs to lower the blood pressure, strengthen the heart, or prevent infection and blood clots. In extreme cases, a surgeon may remove clots or replace one or more diseased blood vessels.

Other disorders result from damage or defects in the heart or blood vessels. For example, bacteria may harm or destroy the valves that control the flow of blood through the heart. Incomplete development of the heart or its blood vessels before birth may produce defects called *congenital heart disorders.* Many cases of damage or defects can be corrected by surgery.

The circulatory system in other animals

Vertebrates all have a *closed* circulatory system. In this type of system, the blood flows only in the vessels and remains separate from the fluid in the body tissues. Mammals—including human beings—and birds have a heart with two separate pumps. In these animals, the blood in the systemic and pulmonary circulations almost always remains separate. In amphibians and most reptiles, the pumps of the heart are only partly separated, and the systemic and pulmonary blood mixes together somewhat. In fish, the heart has only one pump. The pump collects the blood and sends it to the gills and then to the rest of the body.

Invertebrates have circulatory systems that range from complex to simple. Some invertebrates, such as earthworms and octopuses, have a closed circulatory system. Other invertebrates have an *open* circulatory system, in which the blood is only partially confined to the vessels. It fills the hollow spaces of the body as well. Animals with an open circulatory system include insects, spiders, and most shellfish.

In many invertebrates, the blood is pumped by contracting vessels or by *pumping centers* (contracting portions of vessels), or by both. Among insects, for example, the "heart" consists of an internal contracting vessel that extends almost the length of the back.

The simplest animals with a true circulatory system include certain kinds of worms. Earthworms, leeches, and a variety of sea worms have contracting vessels that pump the blood. A group of simpler worms, called *ribbon worms* or *proboscis worms,* have a circulatory system with no pumping centers and no contracting vessels. The movements of the animal keep the blood flowing through the body. Francis L. Abel

Related articles in *World Book* include:

Artery	Heart	Lung
Blood	Human body (Trans-Vision)	Lymphatic system
Capillary		Vein

Circumcision is the surgical removal of the skin that covers the head of the penis. An uncircumcised penis has a loose fold of skin called the *foreskin* or *prepuce* that covers the *glans* (head of the penis). A physician removes the foreskin by cutting around the penis where the foreskin is attached. *Circumcise* means *cut around.*

Most circumcisions are performed within a few days of birth. The doctor first discusses the procedure with the parents. The operation is not medically required, and the parents must give permission to perform the operation. The surgery is often performed without an *anesthetic* (painkilling drug). However, many physicians now recommend using some type of anesthetic.

Research shows that circumcision provides some health benefits. Most physicians believe the operation makes the glans and penis easier to clean and thus helps prevent infection. Uncircumcised males are more prone to infections of the *urinary tract,* the structures that produce and eliminate urine. Circumcised males may also have a lower risk of infection with many sexually transmitted diseases, including syphilis, gonorrhea, and HIV, the virus that causes AIDS. A painful condition called *phimosis (fy MOH sihs)* occurs when the foreskin tightens around the head of the penis, often as a result of scarring due to infection. Circumcision prevents this condition, which can block the flow of urine.

Circumcision also greatly reduces the risk of developing cancer of the penis. This cancer is relatively rare, occurring in about 1 out of 400 uncircumcised males.

Today, circumcision is performed largely for cultural or religious reasons. Many parents choose to have their sons circumcised because the father is circumcised, or because the operation is common where they live. Many ancient societies performed it when a boy matured into a young man. Circumcision was a sign that the youth should assume the religious duties of an adult.

The Bible includes many references to circumcision as a sign of membership in the Jewish community. Circumcision became an important rite in Judaism. A traditional Jewish circumcision is performed by a person called a *mohel (MOY ehl)* on the eighth day after the baby's birth. Muslims also regard circumcision as part of their religion. Muslim boys are circumcised sometime between infancy and about 14 years of age.

A procedure sometimes called *female circumcision* is practiced by many ethnic groups, particularly in Africa and the Middle East. The procedure, also known as *female genital mutilation,* involves the partial or complete removal of the *clitoris,* a sensitive part of the female genitals, and the surrounding tissue. In cultures where the operation is performed, it is considered an important part of a woman's preparation for marriage. Because there is no health benefit from the procedure, it is condemned by many human rights organizations and medical authorities. Risks associated with the procedure include blood loss, infection, lasting pain, and a reduced ability to enjoy sexual relations. Thomas E. Wiswell

Circumference. See Circle.



© Feld Entertainment

A circus presents a variety of performers, including acrobats, clowns, dancers, and musicians. A circus traditionally opens with a lavish production number called a *spectacle, shown here.*

Circus

Circus is a live production that features daring and graceful acts by a cast of acrobats, aerial artists, clowns, and other performers. Traditional circuses also feature trained animals. The circus band and dancers in elaborate costumes add to the color and excitement. A ringmaster serves as master of ceremonies, singing and introducing many of the acts.

Audiences enjoy a circus for its pageantry and even more for its thrills and danger. Circus artists risk serious injury or even death by performing in cages with wild animals, flying through the air in a trapeze act, or walking on a high wire many feet or meters above ground.

The circus is one of the most international of art forms. A large circus will include performers from throughout the world. A show might include acrobats from China, tumblers from Bulgaria, animal acts from Germany, high wire walkers from Spain, trapeze artists from Mexico, and clowns from the United States.

At the circus

Traditional circus performances open and close with a lavish production number called a *spectacle.* As the band plays, the ringmaster sings, and performers in elaborate costumes parade in front of the audience. Such animals as camels, elephants, dogs, horses, llamas, and zebras take part in the parade. The spectacle may end with a trick called a *long mount,* in which the elephants stand in a line with their front legs resting on the backs of the elephants in front of them.

Most of the show consists of circus acts, which take place in round areas called *rings.* A circus may have from one to three rings, though some circuses perform in an open area with no rings. In a three-ring circus, similar acts may appear in all the rings at the same time. These acts are known as a *display.* For example, three groups of acrobats may perform at one time, followed by three animal acts.

Circus acts feature an astonishing variety of talent by people and animals. One circus artist may perform back flips on a high wire. A *flyer* gracefully somersaults through the air into the hands of another aerial artist, who hangs by the knees from a trapeze. Chimpanzees ride around the the ring on bicycles, and dogs jump rope. Tigers leap through hoops of fire. *Liberty horses* (horses without riders) race around a ring and execute intricate maneuvers.

Clowns entertain the audience before and during the performance. In one popular clown gag, about a dozen clowns emerge from a tiny car. Clowns walk on stilts, ride unicycles, juggle, or perform short, silly pantomime plays.

The circus band plays throughout the show. The musicians, directed by a conductor, often make quick adjustments in the music to follow the live action. A typical circus band performs music ranging from traditional circus marches to jazz, blues, and rock music.

Behind the scenes

A number of key people work together to stage an elaborate and complex circus performance. A director supervises the overall performance, assisted by a *choreographer* who creates the many dance routines that are part of the show. Costume designers plan the colorful costumes that have become part of the circus tradition.

Most circuses travel by truck. The performers, staff, and workers travel and live in privately owned motor homes. Animals ride in specially designed stock trailers.

Workers called *roustabouts* unload and set up the equipment for the various acts. The roustabouts must quickly and efficiently erect and take down the equip-

LaVahn G. Hoh, the contributor of this article, is Professor of Drama at the University of Virginia and co-author of Step Right Up! The Adventure of Circus in America.



Ringling Bros. and Barnum & Bailey Combined Shows, Inc.

Animal acts provide great excitement for audiences. These lions perform tricks on commands from their trainer. To protect the spectators, the animals perform inside a wire cage.



Ringling Bros. and Barnum & Bailey Combined Shows, Inc.

Clowns in funny costumes and colorful makeup entertain the audience with their playful antics and humorous stunts. They often use comic or unusual objects as props in their acts.



Ringling Bros. and Barnum & Bailey Combined Shows, Inc.

Human cannonballs are circus daredevils who fly through the air after being shot out of a cannon. These performers will land in a safety net on the other side of the arena.

ment during a performance. After the last performance in a city, the workers pack all the equipment so it can be moved to the next location.

A traveling circus is like a small, self-contained community. The circus provides meals for the workers. A circus may also have its own barber, school, veterinarian, and doctor and first-aid unit.

Joining the circus

Before joining a circus, an individual must realize that the circus has its own lifestyle. A performer in a typical circus travels for much of a year, moving from city to city. Some circuses have two or three shows a day for five or six days every week.

For many years, most circus performers grew up in the circus, learning their skills from members of their families. Now a performer can join a circus by training for it. Some noted circus schools are supported by national governments. The Soviet Union had a tradition of training circus artists through state-supported schools, beginning with the Moscow Circus School, established in in 1927. But many of these schools closed after the Soviet Union broke apart in 1991. Other countries still have state-supported training schools, including L'Ecole Superiéure des Arts du Cirque (National School of Circus Arts) in France and L'Ecole Nationale de Cirque (National Circus School) in Canada. In the United States, people can learn circus skills at some universities, at training schools sponsored by circuses, and at clubs and YMCA's.

History

Roots of the circus. Many elements of the modern circus have existed for more than 2,000 years. For example, in 2500 B.C., circus-type performers, such as acrobats and balance artists, performed in Egypt. Acrobats jumped over bulls on the island of Crete by the 1500's B.C. Performers spun plates on bamboo poles at a theater school in China in A.D. 714. Many aspects of the modern circus appear in ancient Greek culture. For example, the strong man and the comic mime, a forerunner of the clown, originated in ancient Greece.

Surviving examples of circus activity support the notion that the modern circus had its roots in ancient Rome. Chariot races took place in a round or horseshoe-shaped structure called a *circus*, the Latin word for *circle* or *oval*. These races eventually included circuslike entertainment.

After the collapse of the Roman Empire in western Europe in the A.D. 400's, entertainers called *minstrels, troubadours*, and *jongleurs* traveled throughout Europe, entertaining people with circuslike skills. In the Chinese classical theater, the white-faced clown became one of the four basic types of roles in Chinese drama. In the 1400's, plays in China included people jumping through hoops lined with swords, or turning somersaults on a ladder.

The birth of the circus. The modern circus was developed in England by Philip Astley, a former sergeant major of the British Cavalry. In 1768, Astley opened an *equestrian* (horseback riding) school in London. He taught riding in the morning and performed "feats of horsemanship" in the afternoon. Astley performed in a circular arena later referred to as the *ring*. After two years of demonstrating his "feats of horsemanship," Astley added other entertainment. Between riding acts, he inserted performers who juggled, walked a tightrope, or demonstrated acrobatic skills. He also added a clown. By combining these elements of entertainment, Astley founded the modern circus.

In 1782, two Englishmen, a riding teacher named Charles Hughes and a dramatist and composer named Charles Dibdin, opened an equestrian school that rivaled Astley's. The men called their school the Royal Circus and Equestrian Philharmonic Academy, the first time the word *circus* was used to refer to a combination of equestrian and other acts.

In 1793, Hughes traveled to Russia at the invitation of the Empress Catherine the Great. He introduced the circus at the empress's court in St. Petersburg, and the new form of entertainment quickly spread throughout Russia.

Also in 1793, Hughes's student John Bill Ricketts opened the first American circus in Philadelphia. Ricketts established the first Canadian circus in Montreal in 1797. Philip Lailson, a British equestrian, introduced the circus to Mexico in 1802.

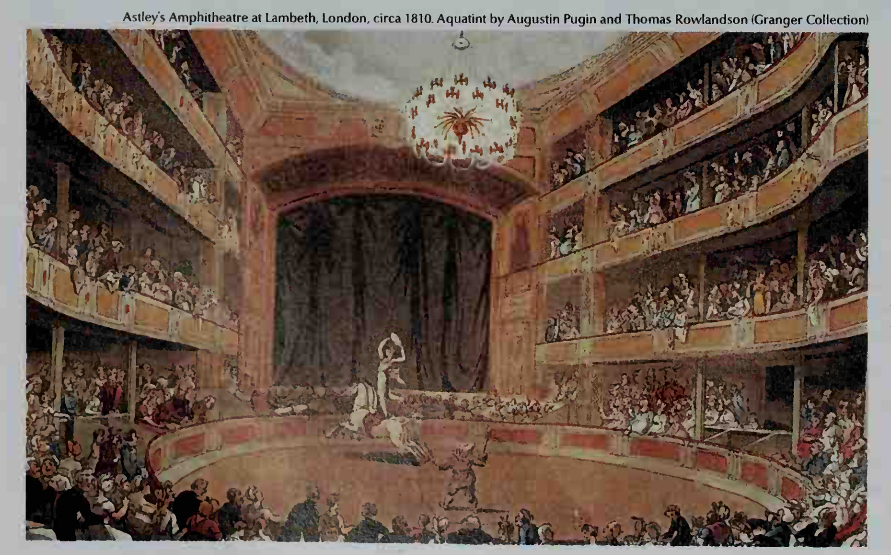
The circus grows. By the early 1800's, the circus had spread throughout Europe and the United States. The first circus performances took place in temporary wooden structures. Soon, however, almost every major city in Europe had at least one permanent building for the circus. Some circuses in the United States also had permanent structures.

While the European circus developed in permanent buildings, the circus in the United States took a different path. Joshuah Purdy Brown wanted to take entertainment and spectacle to America's small towns, so in 1825 he introduced circus performances under a tent. The circus could now travel to more places using this portable structure. By the 1830's, most American circuses performed in tents.

Brown came from the area of Somers, New York, which has been called the "cradle of the American circus." In Somers, a cattle dealer named Hachaliah Bailey bought an African elephant and exhibited it. The popular response to the elephant led Bailey to import more animals from other countries and create a traveling menagerie. Perhaps the most famous menagerie of the early 1800's, called the Zoological Institute, had been formed in the Somers area. The traveling circus and menagerie business had begun.

The American circus started with single acts in one ring and gradually developed into three or more rings.

Astley's Amphitheatre at Lambeth, London, circa 1810. Aquatint by Augustin Pugin and Thomas Rowlandson (Granger Collection)



Astley's Amphitheatre was opened in 1777 in London by Philip Astley, who is credited with developing the modern circus. In the amphitheatre, Astley mixed circus acts with theater. A ring near a stage featured circus tricks with horses.



©Corbis

The Golden Age of the American circus extended from the 1870's through the 1920's. Large circuses, such as the Sells Brothers Circus, traveled throughout the United States, performing in giant canvas tents. This poster from 1895 shows the circus set up next to a railroad station. Patrons could get off a train and walk directly to the circus.

By the end of the 1800's, methods of travel for the circus varied from horse-drawn wagons to riverboats and railroad trains. In 1868 and 1869, a circus and menagerie owned by Dan Castello, a former clown, became the first circus to make a transcontinental tour, much of it by rail.

The Greatest Show on Earth was the name given to his circus by the American promoter and showman P. T. Barnum after he joined with circus owners Castello and William C. Coup to form P. T. Barnum's Grand Traveling Museum, Menagerie, Caravan and Circus in 1871. This show exhibited animal and human oddities, which eventually became a standard part of the American circus known as the *side show.*

Barnum's circus imported the African elephant Jumbo from the London Zoo in 1882. The animal became a sensation. The circus also staged large street parades to promote its shows. Barnum's parades established the practice for other circuses for decades. After a traveling circus arrived in town, a procession of performers, animals, and brightly painted wagons drawn by teams of horses would parade down the main street to attract people to the circus performances.

The circus goes international. During the mid-1800's, the circus expanded to many parts of the world. In 1836, Thomas T. Cooke, an English showman, visited the United States. When he returned to England in 1840, he took with him the idea of the circus tent. An Italian showman named Giuseppe Chiarini managed a touring circus that traveled throughout the world. An Australian

Circus World Museum, Baraboo, Wisconsin



The circus parade was a tradition in the United States for many years. This 1908 scene shows a crowd watching the animals and circus wagons parade through the town. The procession took place after the circus arrived in a town to advertise upcoming performances.

pubkeeper named Robert A. Radford established the first true circus in Australia, Radford's Royal Circus, in 1847. A French equestrian, Louis Soullier, introduced the circus to China in 1854. When he returned to Europe in 1866, he introduced Chinese acts, such as perch-pole balancing, plate spinning, and juggling.

Following the death of P. T. Barnum in 1891, a showman named James A. Bailey, Barnum's partner, acquired the circus and shipped the entire show to Europe for a tour that lasted from 1897 to 1902. During this tour, European circus owners were amazed at how easily Bailey's circus could be loaded, set up, torn down, and moved. Bailey's show traveled on specially designed trains.

The Ringling Brothers. After Bailey returned to the United States in 1902, he discovered that he had serious competition from the five Ringling brothers from Baraboo, Wisconsin. The brothers presented their first show in 1884. They hired an old showman named Yankee Robinson to lend his name and advise them. The show was named Yankee Robinson and Ringling Bros. Great Double Shows, Circus and Caravan, but the Yankee Robinson name was used for only one season.

By 1892, the Ringling Bros. Circus was traveling to 12 states on 31 railroad cars and presenting its show in a tent larger than a football field. After Bailey's death in 1907, the Ringling brothers purchased the Barnum and Bailey circus. They combined it with their show in 1919 to form Ringling Bros. and Barnum & Bailey Combined Shows, The Greatest Show on Earth.

The Golden Age refers to the period in circus history from the 1870's through the 1920's. The circus reached a peak of popularity during this time. Large traveling circuses of the Golden Age included the Cole Bros., Hagenbeck-Wallace, and Sells-Floto circuses in the United States; Lord George Sanger's Circus and Chipperfield's Circus in the United Kingdom; and the Wirth Bros. Circus in Australia. The tent circus expanded from one to three rings. As tents grew longer and wider, they also grew taller to allow for aerial acts. At the same time, because of the great size of the tent, singing and talking clowns began to fade away and clowns turned to mime.

The larger circuses bought out many of the smaller shows. By 1929, for example, virtually every major circus in the United States was owned by the American Circus Corporation, a company based in Peru, Indiana, or by the Ringling Circus led by John Ringling, the last of the five brothers. In 1929, Ringling purchased the American Circus Corporation, making him the undisputed king of the American circus.

The middle and late 1900's. The Great Depression of the 1930's led to a decline in circuses. Many circuses went out of business or combined with other shows during the difficult economic times. The circus also faced competition from new forms of entertainment, first motion pictures and then television.

In 1956, the Ringling Bros. and Barnum & Bailey Circus abandoned the railroad for truck travel, and became an arena rather than a tent show. In 1967, the Ringling Bros. circus was purchased by Irvin Feld, a leader in the entertainment field. In 1969, Feld created a second unit for the circus by buying the Circus Williams of Germany, thus obtaining the services of the famous animal trainer Gunther Gebel-Williams.

Since the early 1800's, approximately 2,000 circuses have come and gone in the United States alone, and hundreds more in other countries. Many of these shows failed to keep up with changes in circus production, the economy, or competition from other forms of entertainment.

The circus today

The circus today survives in two major forms, traditional circuses and an innovative approach sometimes called "new wave" circuses. The Ringling Bros. and Barnum & Bailey Circus is the oldest and best known of the traditional American circuses. Traditional circuses in other countries include Billy Smart's Circus and the

AP/Wide World



The Cirque du Soleil is a revolutionary new style of circus that originated in Canada in 1984. The Cirque du Soleil emphasizes modern technology, striking special effects, dramatic lighting, and imaginative costumes. But Cirque du Soleil productions still feature acrobats, aerialists, and other traditional circus acts.



Ringling Bros. and Barnum & Bailey Combined Shows, Inc.

An aerial ballet is a thrilling spectacle. These performers twirl hoops around their arms while they hang suspended by their ankles from ropes high above the floor of the arena.



© Harlee Little

The UniverSoul Circus combines African American acts with entertainers from Africa. This troupe of acrobats from the African nation of Gabon performs in traditional African costumes.



Ringling Bros. and Barnum & Bailey Combined Shows, Inc.

A high-wire team performs on a cable high above the ground. The performer on the bottom uses a pole for balancing. Safety cables attached to the performers protect them in case of a fall.



European Entertainment Corporation

The Chinese State Circus features daring and graceful acrobatic performances. In this act, an acrobat leaps through a hoop and over a row of other performers doing headstands.

Blackpool Tower Circus in the United Kingdom, Fossett's Circus in Ireland, and Ashton's Circus and the Lennon Brothers Circus in Australia. Some long-established traditional circuses, such as the Chinese State Circus and the Moscow State Circus of Russia, travel to many countries.

Many new wave circuses are intimate shows, performed in a single ring under a tent. Many omit the spectacle of larger circuses. Some of the best-known new wave circuses include the Big Apple Circus, established in New York City in 1977; Circus Oz, started in Melbourne, Australia, in 1978; Cirque du Soleil (Circus of the Sun), begun in Montreal, Canada, in 1984; Circus Flora, founded in Camden, South Carolina, in 1985; and the UniverSoul Circus, begun in Atlanta, Georgia, in 1994. The Big Apple Circus is patterned after one-ring European circuses with an emphasis on equestrianism. Circus Oz includes off-beat humor, political jokes, and social satire in its acts. Cirque du Soleil has no animals, only human performers. Live vocalists sing its music in an invented language. Its productions emphasize modern technology, with striking special effects and imaginative, often bizarre costumes. Some of Cirque du Soleil's shows continually tour the world, while other productions reside in permanent theaters in several cities. Circus Flora is a traveling one-ring show that now makes its home in St. Louis, Missouri, under its parent organization, the Circus Arts Foundation of Missouri. The UniverSoul Circus combines African American acts with acts from Africa.

The new wave shows, with their fresh approach to the circus arts, had a profound effect on the circus industry.

Some critics credit these circuses with improving the quality of other circuses in their lighting, music, costumes, pacing, and mix of acts.

Places to visit and annual events

Several important museums and circus collections exist throughout the United States. The Circus World Museum stands in Baraboo, Wisconsin, the original home of the Ringling brothers. Part of the museum is housed in the original headquarters of the Ringling circus. The museum exhibits the largest collection of circus wagons in the world. It also has the largest library and research center in the world devoted exclusively to the circus. Each year, many of the museum's circus wagons travel to Milwaukee for the Great Circus Parade. More than 600 horses pull more than 75 classic circus wagons in the parade.

The Ringling Museum of the Circus in Sarasota, Florida, shows the history of the Ringling circus. It also displays records, wagons, and posters from other circuses.

The Barnum Museum in Bridgeport, Connecticut, offers a unique look at the great showman P. T. Barnum. The three-story museum displays many objects that led to the creation of "The Greatest Show on Earth."

The Hertzberg Circus Collection and Museum is housed in the San Antonio Public Library in Texas. The museum contains valuable information on the development of the circus in the United States from the 1800's to the mid-1900's.

The International Circus Festival of Monte Carlo in Monaco ranks as perhaps the most important circus festival in the world. The festival presents awards to outstanding circus acts that are considered the Academy Awards of circus performance. The highest award is the Gold Clown.

The Circus City Festival in Peru, Indiana, is held every July. Young people from the age of 7 to 21 present performances over an eight-day period.

The National Circus Festival of Australia is held at various locations in Australia. It provides training in the circus arts, including juggling, trapeze, clowning, and acrobatics. In addition to workshops, the festival presents performances to the public.

The World Festival of the Circus of Tomorrow in Paris is held every year to promote young circus performers. It features performers in two age groups—Circus of the Future (ages 12 to 18) and Circus of Tomorrow (ages 19 to 25). LaVahn G. Hoh

© Charly Gallo, Centre de Presse

The International Circus Festival of Monte Carlo in Monaco, *shown here,* is perhaps the most important circus festival in the world. Circus acts compete at circus festivals in many countries.

Related articles in *World Book* include:

Barnum, P. T.
Buffalo Bill
Clown
Hagenbeck, Carl
King, Karl
Lion (Training lions)
Ringling brothers
Rome, Ancient (Recreation)
Stratton, Charles S.
Wisconsin (Places to visit)

Outline

Questions

Who are circus *roustabouts?*
What are considered the Academy Awards of circus performance?
Where and when was Cirque du Soleil founded?
When was the "Golden Age" of the circus?
What was a *side show?*
What was the importance of Philip Astley in circus history?
Where can individuals receive training in circus arts?
Who introduced the tent to the American circus?
Where is the Circus World Museum?
What is a *spectacle?* A *display?*

Additional resources

Burgess, Ron. *Be A Clown!* Williamson, 2001.
Fox, Charles P., and Parkinson, Tom. *The Circus in America.* 1969. Reprint. Hennessey & Ingalls, 2002.
Granfield, Linda. *Circus: An Album.* 1997. Reprint. D K Pub., 1998. Younger readers.
Sugarman, Robert. *Circus for Everyone: Circus Learning Around the World.* Mountainside Pr., 2001.

Cirrhosis, *suh ROH sihs,* is a disease of the liver in which scar tissue forms throughout the organ. Groups of cells called *regenerative nodules,* surrounded by sheets of scar tissue, replace the normal spongy tissue of the liver. The diseased organ may be unable to perform such vital functions as manufacturing proteins and removing harmful substances from the blood. The affected tissue may block the flow of blood, causing high pressure in the blood vessels that serve the liver. Internal bleeding may then result. In addition, the blockage may lead to the accumulation of fluids inside the abdomen.

Many people with severe cirrhosis become weak and



Edmond Nagele, The Photo Source

A citadel is a fortress built to defend a city. Most citadels stand on a hill overlooking the city they protect. The citadel shown here is Dover Castle, which stands on a cliff near Dover, England, facing France across the Strait of Dover.

disoriented. Severe cases can cause death. But some cases do not even cause noticeable symptoms.

Cirrhosis results from injury to the liver. Excessive use of alcoholic beverages or *hepatitis* (inflammation of the liver) may cause such injury. Inhaling the fumes of certain chemicals, such as carbon tetrachloride, also may cause cirrhosis. After scar tissue forms, the liver cannot regain its sponginess. Some cases of cirrhosis can be controlled by proper diet and by avoiding liquor.

Charles S. Lieber

Cirrus. See **Cloud.**

Cisneros, *sees NAY rohs,* **Henry Gabriel** (1947-), became the first Hispanic American to serve as United States secretary of housing and urban development. He held the post from 1993 to 1997, serving under President Bill Clinton. Earlier, Cisneros had been the first Mexican American to be elected mayor of a major U.S. city. He was elected mayor of San Antonio in 1981. He won reelection three times and served as mayor until 1989.

Cisneros returned to private life in 1997, after leaving the Cabinet. Later that year, he was charged with having lied in the background investigation that took place before he was confirmed as housing secretary. Investigators charged that Cisneros had not told the truth about the amount of financial support he was providing for a woman he had once had an affair with. In 1999, just before his trial was about to start, Cisneros pleaded guilty to the charge of lying. The court fined him $10,000.

Cisneros was born in San Antonio. He earned bachelor's and master's degrees at Texas A&M University. Cisneros also received graduate degrees from Harvard University and George Washington University. In 1974, he joined the faculty of the Division of Environmental Studies at the University of Texas at San Antonio.

Cisneros was elected to San Antonio's city council in 1975 and was reelected twice. As a council member, he emphasized economic development and cooperation between the city's Hispanic and white residents. Hispanic Americans formed the largest ethnic group in San Antonio. In the 1981 mayoral campaign, Hispanic Americans cast most of the votes Cisneros received, but many whites also supported him. As mayor, Cisneros helped strengthen the urban and business communities of downtown San Antonio. Homer D. C. Garcia

Cistercians are monks and nuns who belong to two Roman Catholic religious orders throughout the world. Their daily routine follows a *rule* (set of guidelines) established by Saint Benedict of Nursia. This rule emphasizes prayer, study, and manual labor.

There are two orders of Cistercians—the Common Observance and the Strict Observance. Monks of the Common Observance sometimes teach and provide spiritual guidance in their communities. Nuns lead secluded, prayerful lives. The order of the Common Observance was formerly called the Sacred Order of Cistercians. Both monks and nuns in the Strict Observance lead secluded lives. The monks are popularly called *Trappists* and nuns, *Trappistines.* See **Trappists.**

Cistercian orders trace their history to a French monastery founded in 1098 at Cîteaux (Cistercium) by the abbot Saint Robert of Molesme. Orders of Cistercian nuns were founded about 1120. E. Rozanne Elder

Citadel, *SIHT uh duhl,* is a high, walled fortress built to defend a city. A citadel usually stands on a high hill overlooking a city. In early days, its walls surrounded the palace of the ruler.

The citadels of Mycenae and Tiryns in Greece were important ancient fortresses. The citadel known as Acrocorinth, built on a hill more than 1,800 feet (549 meters) high, guarded the Greek city of Corinth. The French citadel of Carcassonne was an important stronghold during the Middle Ages. The best-known citadel in North America stands atop Cape Diamond in Quebec, Canada. The French built it about 1665, and the British rebuilt it from 1823 to 1832. A. J. Busch

See also **Acropolis; Carcassonne; Quebec** (city), the section *The city.*

Citibank is one of the largest banks in the world. It has more than 290 branches in the New York City metropolitan area and about 3,000 offices in 93 countries. The

bank's history dates from June 16, 1812, when the New York state legislature granted a charter to the City Bank of New York. The bank entered the national system in 1865. In 1955, the National City Bank merged with the First National Bank of the City of New York to form the First National City Bank of New York. The name of the bank was changed to Citibank in 1976. The bank is a subsidiary of Citigroup, a multinational financial services organization. Critically reviewed by Citibank

Cities. See City.

Cities of refuge were six cities of ancient Palestine. They were set apart as places of refuge for people who had killed other persons either accidentally or in self-defense. They included Bezer, Ramoth-Gilead, and Golan, on the east side of the River Jordan, and Kedesh, Shechem, and Hebron on the west side of the river (Joshua 20). Persons who fled to one of these cities were protected from avengers until a trial could be held. If found not guilty of willful murder, they were allowed to continue living in the city. If declared guilty, they were returned for punishment to the place from which they had fled. See also **Hebron.** H. Darrell Lance

Citizen King. See Louis Philippe.

Citizens band radio is a method of short-distance communication used by private citizens. It operates on the *citizens band* (CB), a group of radio frequencies that many nations reserve for private use.

CB radio is most frequently used for conversations between places that are not linked by telephone. Many motorists and truck drivers use it to talk with other highway travelers or people who are in an office or at home.

Most CB sets are devices called *transceivers,* which consist of a transmitter and a receiver. Some CB devices receive radio signals but do not transmit them.

Most CB transmitters broadcast for distances of fewer than 5 miles (8 kilometers) in cities and up to 20 miles (32 kilometers) in rural areas. The broadcast range varies with the atmospheric conditions, the terrain, the design and height of the set's antenna, and the amount of power supplied to the transmitter. Government regulations in the United States and Canada limit the power of a CB transmitter to a maximum of 4 watts. In both countries, CB radio has 40 channels, with frequencies of 26.965 to 27.405 megahertz. The Canadian CB is called *General Radio Service.*



WORLD BOOK photo by Ralph Brunke

Citizens band radio often serves as a communication link between motorists. For example, truckers and other drivers keep one another informed about road conditions and the weather. They also use citizens band radios during emergencies.

In the United States, there are no licensing requirements for the operation of citizens band radios. But Canada requires a CB transmitter of more than one-tenth watt to be licensed. A Canadian citizen may obtain a General Radio Service license from the nearest district office of the Department of Communications.

Remote controls for such devices as model airplanes and automatic garage-door openers also operate on CB radio frequencies. For more information on remote control, see **Remote control.** Stanley R. Alten

Additional resources

Chilton's CB Handbook—40 Channel: Guide to Choosing, Installing & Operating Citizens Band Radio, Cars, Trucks, RV's, Vans, Marine, Base. Rev. ed. Chilton, 1977.
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Citizenship is full membership in a nation or in some other unit of government. Citizenship is also called *nationality.* Almost all people have citizenship in at least one country. Citizens have certain rights, such as the right to vote and the right to hold public office. They also have certain duties, such as the duty to pay taxes and to serve on a jury.

Not all the people in a nation are citizens of that country. For example, many countries have noncitizen nationals. The word *national* is often used as another word for *citizen.* In some cases, however, *national* means *a person who owes loyalty to a country but lacks full membership in it.* Noncitizen nationals of the United States include the people of American Samoa, a group of Pacific islands controlled by the United States. The people of American Samoa have the protection of the U.S. government but lack some of the special rights of citizens.

People who are neither citizens nor noncitizen nationals of a country are *aliens* there. Most aliens are citizens or noncitizen nationals of one country who are traveling or living in another. Many aliens have a permit called a *visa* allowing them to visit or live where they do not hold citizenship. *Illegal aliens* are noncitizens living in a country without proper papers.

The laws or beliefs of a country might deny some rights to certain citizens. Such people are sometimes called *second-class citizens.* Many have a language, race, or religion different from that of the country's largest or most powerful group. For example, the South African government considered blacks second-class citizens for many years. In 1948, it established a policy of rigid racial segregation called *apartheid.* Under apartheid, blacks and other nonwhites faced official discrimination in education, employment, and other areas. In addition, blacks were not allowed to vote in national elections. In 1991, the government repealed the last of the laws that had formed the legal basis of apartheid. In 1994, the country held its first national elections in which blacks were allowed to vote.

Under the Constitution and other laws, no American may be made a second-class citizen. Citizens receive equal protection of the law, no matter what their race, color, or religion. But some Americans treat certain groups as second-class citizens despite the law.



©Shepard Sherbell, Picture Group

Voting



Jim Pickerell, FPG

Jury duty



©Ira Wyman, Sygma

Volunteer work

Citizenship involves both rights and responsibilities. Citizens are guaranteed such privileges as the right to vote, the right of free speech, and freedom of religion. Citizens are also expected to obey laws, serve on juries, help in their communities, and perform other duties.

The word *citizen* comes from the Latin word *civitas,* which in ancient times meant *membership in a city.* Today, citizenship refers mainly to membership in a nation.

What it means to be a citizen

The rights of citizens differ from nation to nation. The Constitution of the United States provides the basic rights of American citizens, and laws passed by Congress give additional rights. These rights are called *civil rights.* They include freedom of speech, freedom of religion, and *freedom of assembly* (the right to gather peacefully for political or other purposes). American citizens have the right to vote for the President and members of Congress and to run for government office themselves. U.S. citizens have the right to travel throughout the United States. American citizens, unlike those of some countries, cannot be forced to leave their homeland. American citizenship cannot be taken away, except for certain serious actions.

Aliens and noncitizen nationals share many of the rights of U.S. citizens. But they cannot vote, hold public office, or do certain other things that citizens can do.

The rights of citizens have certain limits. For example, U.S. citizens must be at least 18 years old to vote. States also can limit voting rights to people who have registered to vote. Freedom of speech does not allow a person to tell lies that damage someone's reputation. Many other civil rights also have limits.

The duties of citizens, like citizens' rights, differ from nation to nation. Most governments demand that citizens pay taxes, defend their country, and obey its laws. Some governments require certain citizens to serve on juries.

Many people believe that citizens also have duties not demanded by law, such as voting, learning about public problems, and trying to help other people. Many of these duties go along with rights. For example, the duty to vote comes with the right to vote. The duty to learn about public problems comes with freedom of speech and of the press, which protect the open discussion of public events and the exchange of ideas.

Aliens must obey the laws of the country in which they are traveling or living, except for those that bind only citizens. In addition, aliens must obey some of the laws of their homeland. For example, some foreigners who work in the United States must pay taxes both to the U.S. government and to the government of their own



Andrew Sacks, Black Star

A naturalization ceremony, *left,* is the final step in the legal process by which foreigners become citizens of a country they have adopted. In the United States, many naturalization ceremonies take place on Citizenship Day, September 17.

country. Travelers who break the laws of a country they are visiting may be put on trial and fined or imprisoned. Many nations grant *diplomatic immunity* to aliens who represent foreign governments. Diplomatic immunity is a set of special rights granted to the representatives of foreign governments and to the representatives' families and staffs. In many countries, these rights include freedom from arrest, search, and taxation.

Ways of becoming a citizen

Nations have various laws that govern the granting of citizenship. People become citizens in two ways: (1) by birth and (2) by naturalization.

Birth. Most people become citizens of a country simply by being born there. The right to citizenship in the country of one's birth is called *jus soli* (pronounced *juhs SOH ly*), a Latin phrase that means *right of soil.* The laws of most nations, including Canada, the United Kingdom, and the United States, grant citizenship based on jus soli. Some nations limit jus soli to children whose parents already have citizenship in that nation. Some nations also deny jus soli to certain groups of persons. Such persons include children who are born in a country where their parents are serving as diplomatic representatives. Persons denied jus soli also include babies born to *refugees* (persons who have been forced from their homeland by war or some other difficulty).

Some countries use another rule of citizenship instead of jus soli—or in addition to it. This rule provides that the citizenship of children is determined by the nationality of their parents, no matter where the children are born. The right to citizenship in the country of one's parents is called *jus sanguinis* (pronounced *juhs SANG wuh nuhs*). This phrase is a Latin term that means *right of blood.* Canada, France, the United States, and a number of other nations grant jus sanguinis to children born abroad if one or both parents are citizens.

Naturalization is the legal process by which foreigners become citizens of a country they have adopted. Each nation sets requirements that aliens must meet to become naturalized. For example, aliens cannot undergo naturalization in Canada or the United States unless they have lived in their new country for a number of years. On the other hand, Israel allows Jewish immigrants to become Israeli citizens the day they arrive under a rule called the Law of Return. Many nations naturalize only people who understand the rights and duties of citizenship and can use the national language. The United States and certain other countries require aliens to give up citizenship in their homelands to become naturalized.

Naturalization usually takes place in a ceremony in which qualified aliens promise loyalty to their new country. In the United States, many naturalization ceremonies take place on Citizenship Day, September 17.

Treaties or the passage of special laws may naturalize groups of people without the usual naturalization process. For example, an act of Congress naturalized the people of Puerto Rico in 1917. The United States had taken over Puerto Rico through the treaty that ended the Spanish-American War in 1898.

The United States oath of allegiance

Every alien applying for American citizenship must, as the final step, take the following oath of allegiance to the United States:

"I hereby declare, on oath, that I absolutely and entirely renounce and abjure all allegiance and fidelity to any foreign prince, potentate, state, or sovereignty of whom or which I have heretofore been a subject or citizen; that I will support and defend the Constitution and the laws of the United States of America against all enemies, foreign and domestic; that I will bear true faith and allegiance to the same; that I will bear arms on behalf of the United States when required by the law; or that I will perform noncombatant service in the armed forces of the United States when required by the law; or that I will perform work of national importance under civilian direction when required by the law; and that I take this obligation freely without any mental reservation or purpose of evasion; so help me God."

Dual citizenship

Some people hold citizenship in two nations. The condition of being a citizen of two nations is called *dual citizenship* or *dual nationality.*

Some people gain dual citizenship by birth. For example, a baby born to a French family visiting the United States would have U.S. citizenship by jus soli. The baby also would have French citizenship by jus sanguinis. People whose parents are citizens of two countries might have dual nationality by jus sanguinis.

Some people have dual citizenship as a result of naturalization. For example, a nation might allow its naturalized citizens to keep their original citizenship. Such persons could claim citizenship in two countries. Or, a nation might refuse to allow its people to give up their

citizenship. People who declared that they no longer were citizens of such a country and became naturalized in another still would be claimed as citizens by the original nation.

The loss of citizenship

Expatriation is the act of giving up one's citizenship in a country. Such countries as Canada and the United States allow citizens to expatriate themselves. The term *expatriation* also means the act of taking away a person's citizenship in a country.

United States law provides that citizens might be expatriated if they willingly commit certain acts. Such acts include becoming naturalized in another country, promising loyalty to another country, and serving in another country's armed forces or government. An American may also be expatriated for trying to overthrow the United States government by force. U.S. law provides a process by which expatriated Americans can become citizens again.

Statelessness is the lack of citizenship in any country. Children of alien parents are born stateless if the country of their birth does not grant jus soli and the parents' homeland does not grant jus sanguinis. People can become stateless by giving up citizenship in one country without gaining citizenship in another.

Some people become stateless as a result of government action. For example, a government might punish citizens by expatriating them, leaving them stateless. In 1935, the German government led by the Nazi dictator Adolf Hitler expatriated all Jews living in Germany. Many other people become stateless when their homelands are destroyed by war.

In the United States, a stateless person is considered an alien. Unlike other aliens, however, stateless persons have no government from which to ask protection.

U.S. citizenship laws

The Constitution, as it was first written, did not clearly say how citizenship would be granted. The writers of the Constitution probably believed that citizens of the 13 original states would keep their state citizenship after they became citizens of the United States. Later, the United States followed the British practice of granting jus soli. In 1790, Congress adopted laws that provided jus sanguinis to children born to American parents abroad if the father had lived in the United States.

Today, the Constitution protects citizenship mainly through the 14th Amendment. This amendment establishes jus soli for nearly everyone born in the United States. It guarantees citizenship to "all persons born or naturalized in the United States, and subject to the jurisdiction thereof." Only children of foreign diplomats and other persons not *subject to the jurisdiction* (under the authority) of the United States lack jus soli. Under the 14th Amendment, United States citizens automatically become citizens of a state as well, simply by living in that state. A special law grants citizenship to Indians on reservations.

The Supreme Court of the United States has used the Eighth Amendment to limit Congress's powers of expatriation. The Eighth Amendment forbids cruel and unusual punishments. The court has ruled that citizens cannot be expatriated for deserting U.S. military forces during wartime or for avoiding military duty by living abroad during a war.

Other constitutional amendments protect the voting rights of certain groups of citizens. For example, the 15th Amendment states that citizens cannot be denied the right to vote because of their race. The 19th Amendment gives women the vote. The 26th Amendment provides that citizens who are at least 18 years old cannot be denied voting rights because of their age.

The first 10 amendments, known as the Bill of Rights, protect the civil rights of citizens, noncitizen nationals, and aliens. The Bill of Rights provides freedom of speech, religion, and the press. In addition, it safeguards the rights of persons accused of crimes and promises fair treatment by the government in several other matters.

Laws passed by Congress regulate the granting of citizenship by birth and by naturalization. Under jus sanguinis, children born abroad have U.S. citizenship if one or both parents are citizens. If only one parent is a citizen, that parent must have lived in the United States or one of its possessions for 10 years, 5 of them after the age of 14.

Naturalization is limited to aliens who are at least 18 years old. Applicants for naturalization must have lived in the United States for a certain number of years. In addition, they must prove that they understand the U.S. political system, follow generally accepted moral standards, and can use the English language. They also must show that, in the 10 years before naturalization, they have not supported any disloyal political belief or group. Congress often passes laws that excuse certain aliens from one or more of the requirements for naturalization. In many cases, alien children under the age of 18 automatically become U.S. citizens if one or both of their parents become naturalized. Naturalized citizens cannot serve as President or Vice President of the United States. However, naturalized citizens have all the other rights and duties that citizens by birth have.

The McCarran-Walter Act establishes the basic laws of U.S. citizenship and immigration. This act, also known as the Immigration and Nationality Act of 1952, has undergone several changes since its adoption. Originally, the law admitted only a certain number of immigrants of each nationality. But a law passed by Congress in 1965 gave preference to immigrants with skills needed in the United States and to close relatives of U.S. citizens. A 1990 law continued these preferences. Aliens must be admitted as legal immigrants to get U.S. citizenship. People who flee to the United States after being officially certified as refugees may receive immigrant status.

Canadian citizenship

Canada regulates citizenship through the Citizenship Act, which took effect in 1977. Under this law, a person can become a citizen of Canada in any of three ways:

The Canadian oath of allegiance

Every alien applying for Canadian citizenship must, as the final step, take the following oath of allegiance to Canada:

"I swear that I will be faithful and bear true allegiance to Her Majesty Queen Elizabeth II, Queen of Canada, her heirs and successors according to law, and that I will faithfully observe the laws of Canada and fulfill my duties as a Canadian citizen."

(1) by being born in Canada, (2) by having at least one parent with Canadian citizenship, and (3) by being naturalized.

The right to acquire citizenship has certain limits. For example, children born in Canada to foreign diplomats do not automatically become Canadian citizens. Canadian citizens born abroad must fulfill certain requirements to keep their citizenship. To become naturalized in Canada, aliens must be at least 18 years old and must have lived in Canada for at least three years on a permanent basis. They also must know about Canadian history, geography, and government and be able to use French or English. Naturalized Canadian citizens have the same rights and duties as citizens by birth. The rights of Canadian citizens include voting and holding positions in the government.

Canada belongs to the Commonwealth of Nations, an association of independent countries and other political units formerly under British rule. Citizens of Commonwealth nations, including Australia, New Zealand, and the United Kingdom have citizenship in the Commonwealth as well as in their own country.

History

The idea of citizenship developed in the cities of ancient Greece and Rome about 700 B.C. The early Greeks and Romans thought of cities mainly as communities, rather than as geographic places. These communities consisted of citizens linked by such ties as friendship, family relationships, and participation in government. Not all the people of cities had citizenship. For example, ancient Greek and Roman cities denied citizenship to slaves.

The rights of Greek citizens included owning land and taking part in government. Their duties included voting, attending the government assembly, sitting on juries, and giving military service.

The special rights of Roman citizens included owning property, making contracts and wills, and suing for damages. As the Roman government expanded its rule, Roman citizens traveled to other lands to fight wars, rule territories, and conduct business. Roman citizens kept all their special rights when they traveled anywhere in the Roman Empire. The government also began to grant Roman citizenship to people who had never lived in Rome. In A.D. 212, the government granted Roman citizenship to most people throughout the empire, except for slaves.

During the Middle Ages, which lasted from about the late 400's to about 1500, citizenship remained connected with cities. By this time, people thought of cities mainly as geographic places where people lived. During the 1500's and 1600's, nations ruled by kings or queens developed. As a result, people began to think of citizenship as membership in a nation. The people of these nations gave their loyalty to their monarch and were often called *subjects.*

During the 1700's, democracies began to develop. People living in democracies gave their loyalty to the nation instead of to the nation's ruler. As a result, the terms *citizen* and *national* began to replace *subject.*

Robert J. Pranger

Related articles in *World Book* include:

Alien
Bill of rights
Civil rights
Illegal alien
Immigration
Nationalism
Nationality
Naturalization
Patriotism
Voting

Additional resources

Kaplan, William, ed. *Belonging: The Meaning and Future of Canadian Citizenship.* McGill-Queens Univ. Pr., 1993.

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Weizmann, Daniel. *Take a Stand!* Price Stern, 1996. Younger readers. Explains American government and suggests ways young people can get involved.

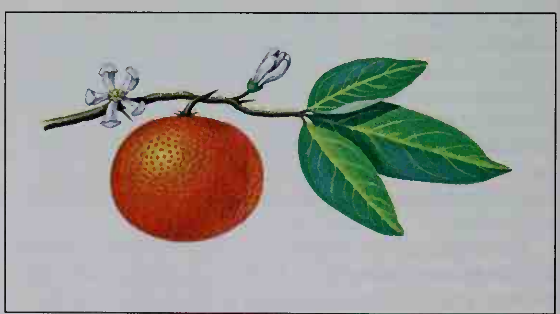
Citizenship Day is celebrated in the United States each year on September 17. The day honors native-born citizens who have reached voting age and naturalized foreign-born citizens. Citizenship Day celebrations include pageantry and speeches to impress Americans with the privileges and responsibilities of United States citizenship.

A movement to recognize new citizens began in 1939. William Randolph Hearst gave it national prominence through his chain of daily newspapers. In 1940, Congress passed a resolution designating the third Sunday in May as I Am an American Day. It authorized the president to issue an annual proclamation urging its celebration.

On Feb. 29, 1952, President Harry S. Truman signed a bill establishing September 17 as Citizenship Day. September 17 is the date on which the United States Constitution was signed in 1787. Under the 1952 law, Citizenship Day replaced I Am an American Day and Constitution Day. However, many cities continue to observe I Am an American Day in May. Jack Santino

Citlaltépetl. See **Orizaba, Pico de.**

Citrange, *SIHT ruhnj,* is a hybrid plant derived from the sweet orange and the trifoliate orange. Although the fruit of the trifoliate orange is not eaten, the plants are hardier than ordinary oranges. Plant breeders developed the citrange to be raised in Georgia and in



WORLD BOOK illustration by James Teason

The citrange looks and tastes like an orange.

other regions of the South where the climate and soil do not allow oranges to grow. Commercial citrus plants have been grafted to the *rootstocks* (underground stems) of some types of citranges, especially Carrizo, Rusk, and Troyer varieties. The rootstocks provide a hardy, disease-resistant system for citrus plants. The citrange orange may grow from 2 to 3 inches (5 to 8 centimeters) in diameter. It has an acid, orangelike taste. The citrange is used in cooking and to flavor various kinds of beverages. Wilfred F. Wardowski

Citrate. See **Citric acid**.

Citric acid, *SIHT rihk,* is a common organic acid that gives lemons, oranges, and other citrus fruits their sour taste. Lemon juice contains 5 to 8 percent of the acid. The name *citric* comes from the Latin word *citrus,* which means *citron tree* (similar to lemon and lime trees). Carl Wilhelm Scheele, a Swedish chemist, first isolated citric acid from lemon juice in 1784.

Citric acid is used as a flavoring for soft drinks and pharmaceuticals. Industry uses it in chemicals, alkyd resins, plasticizers, inks, and as a *mordant* (dye-fixative). It is also used to clean and polish steel, and to preserve color and flavor in canned and frozen fruits and fish. Citric acid is prepared commercially from fermentation of sugar, and by extraction from lemon juice, lime juice, and pineapple canning residues.

Pure citric acid forms colorless, odorless crystals that have a pleasant, sour taste. It is very soluble in water. Its chemical formula is $C_3H_4(OH)(COOH)_3$, and it melts at 153 °C. Citric acid combines with metals to form salts called *citrates.* David C. Armbruster

See also **Acid**.

Citrin, *SIHT rihn,* is a chemical substance that belongs to a group of chemicals called *flavonoids.* Scientists do not know exactly what citrin is, or whether it is essential to the health of human beings. However, they have found that flavonoid substances help to control bleeding from the *capillaries* (tiny blood vessels) in the body. Citrin affects the capillary walls, making them less likely to hemorrhage. The citrin used in medicine is usually prepared from paprika and lemon peel. Citrin was once called *vitamin P,* but it is not a vitamin. Richard A. Ahrens

Citron, *SIHT ruhn,* is a large, usually sour fruit much like the lemon. It ranks among the largest citrus fruits. The citron tree grows wild in northeastern India. It is also grown commercially in Corsica, Greece, Israel, and southern Italy, and the fruit is exported to other countries. The thorny citron tree has leaves that range from 4 to 7 inches (10 to 18 centimeters) in length. The edges of the leaves are slightly toothed.

The fruit is 6 to 10 inches (15 to 25 centimeters) long, or longer, and shaped like an egg. It has a thick, firm *rind* (peel) that is preserved and candied for use in cakes, puddings, and candies. The rind also furnishes fragrant oils. The *etrog,* a variety of citron with small fruits, is grown for use in a Jewish ceremony called the Feast of the Tabernacles.

Scientific classification. The citron belongs to the rue family, Rutaceae. Its scientific name is *Citrus medica.*

Wilfred F. Wardowski

Citronella, *SIHT ruh NEHL uh,* is an oil used in perfumes and in citronella candles. It is also a source of two other ingredients used in perfumes: *citronellal* and *geraniol.*

Citronella comes from various citronella grasses, which are cultivated in many tropical regions. Workers obtain citronella by cutting the grass, leaving it in the sun for a few days to dry, and then distilling it (see **Distillation**). Patricia Ann Mullen

Citrus, *SIHT ruhs,* is the name of a group of trees and shrubs which belong to the rue family. Some citrus fruits are oranges; grapefruits; lemons; mandarins, including tangelos, tangerines, tangors, and their hybrids; kumquats; bitter oranges; limes; citrons; shaddocks; and bergamots. Citrus trees grow wild in parts of India and southeastern Asia. The Chinese were the first to cultivate citrus trees, more than 4,000 years ago. These trees and shrubs have been grown in other parts of the world for their fruits for many years.

Citrus trees are thorny, but usually attractive. They are evergreen, with long, shiny, pointed leaves. The flowers are fragrant. Ripe citrus fruits may be green or yellow to orange-red in color. All citrus fruits are a type of berry that scientists call a *hesperidium.*

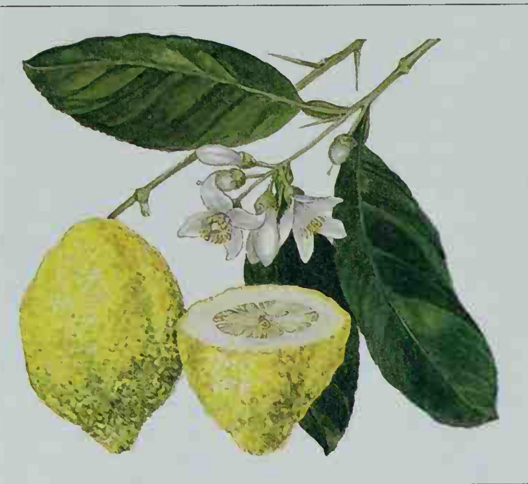
Citrus fruits all grow in rather warm climates. They grow best where there is almost no frost or wind. All grow in tropical regions, but produce better fruit in a slightly cooler climate. Citrus plants grow best in Arizona, California, Florida, and Texas in the United States. Citrus fruits are grown in greater quantity than any other fruit in the United States. Citrus fruits are valuable foods. They contain large amounts of vitamins and minerals. Citrus fruits are usually high in vitamin C.

Scientific classification. Citrus plants are members of the rue family, Rutaceae. This family consists of six genera: *Fortunella, Eremocitrus, Poncirus, Clymenia, Microcitrus,* and *Citrus.*

Wilfred F. Wardowski

Related articles in *World Book* include:

Bergamot	Mandarin
Citron	Orange
Grapefruit	Tangelo
Kumquat	Tangerine
Lemon	Tangor
Lime	



WORLD BOOK illustration by Kate Lloyd-Jones, Linden Artists Ltd

The citron is a citrus fruit that resembles a large lemon. A citron is shaped like an egg and has a thick, firm, pale yellow rind. The fruit grows on the small, thorny citron tree.

Mireille Vautier, Woodfin Camp, Inc.

Crowded street scenes—like this one in Lima, Peru—are common in cities throughout the world. Cities occupy only a small portion of the world's land. But about 45 percent of all people now live in or near cities, and the percentage continues to grow.

City

City is a community where thousands—or even millions—of people live and work. Cities are the world's most crowded places. New York City, for example, had an average of about 21,800 persons per square mile (8,400 per square kilometer) at the 2000 census. At that time, the United States as a whole averaged only about 78 persons per square mile (30 per square kilometer). Similarly, other large cities have population densities that are hundreds or thousands of times as large as their average national population densities.

The percentage of the world's people living in *urban places* (cities and their surrounding areas) keeps growing. In 1800, only about 2 $\frac{1}{2}$ percent of the world population lived in urban places. This figure was about 45 percent in 1990, and it is expected to grow to 55 percent by 2010. In 1800, only about 5 percent of the U.S. population was urban. This figure reached about 75 percent by 1990 and might reach 80 percent by 2010.

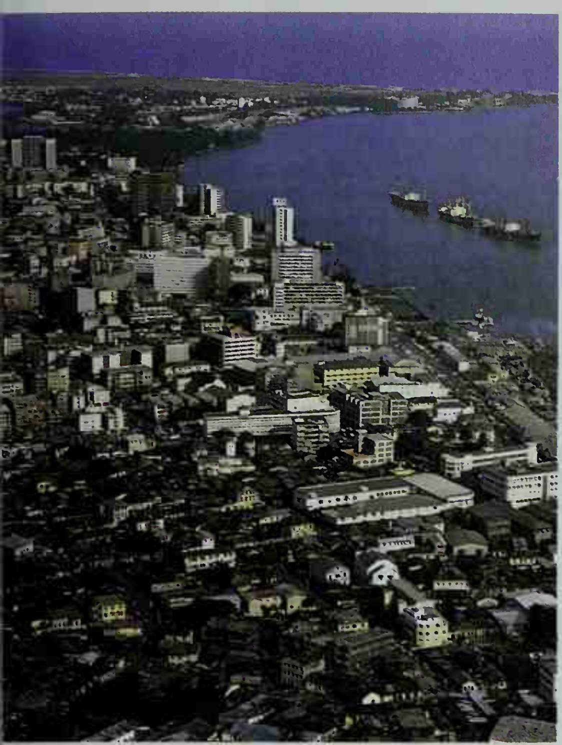
Cities offer many activities for residents and visitors. Art museums display works by famous artists, and musicians perform in classical recitals or rock concerts. Movies from around the world play at local theaters. Restaurants offer food from diverse cultures, and department stores sell a wide range of items. Huge stadiums enable thousands of people to attend sporting events.

Nevertheless, many cities are overcrowded, dirty, and noisy. Traffic jams delay people who are trying to travel to work, stores, or other places. Automobiles and electric power plants dirty the air with fumes that endanger people's health. Motor vehicles, factories, sirens, and construction equipment create bothersome noise. Many cities have a high crime rate, and violence sometimes breaks out between racial or religious groups.

People choose to live in or near cities for several reasons. Many people enjoy the rapid pace and bustling activity of city life. However, the main reason people choose cities is the number and variety of jobs available. The cities of most industrialized nations serve as manufacturing centers. A manufacturing company might provide jobs to many people, such as factory workers and accountants. Far fewer jobs are available in the cities of developing nations, including most of the countries of Africa, Asia, and Latin America. Even so, large numbers of people flock to these cities searching for work.

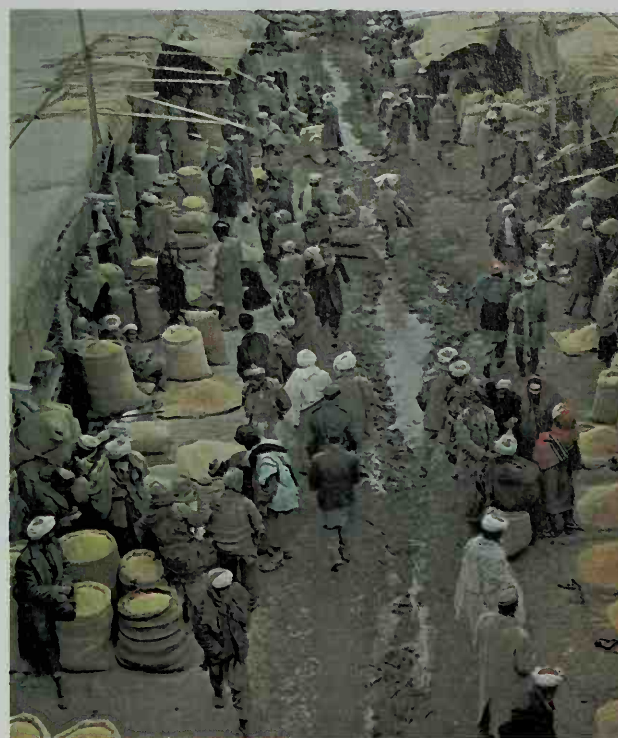
No rule states the number of people a community must have to be classified as a city. In fact, some communities are called cities for reasons that have nothing to do with their population. In the United States, for example, one definition of *city* is any community—regardless of population—that has some form of city govern-

The contributors of this article are Henry C. Binford, Associate Professor of History at Northwestern University; and Terry Nichols Clark, Professor of Sociology at the University of Chicago.



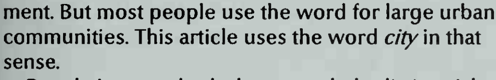
Georg Gerster, Comstock

The business center of a city is packed with tall buildings where people work and shop. In Lagos, Nigeria, *above,* and other cities, residential areas stretch beyond the center.



S. E. Hedin, Carl Östman

Trade and industry provide jobs for millions of city dwellers. An open-air grain market in Kabul, Afghanistan, *above,* helps make that city an important trading center.



ment. But most people use the word for large urban communities. This article uses the word *city* in that sense.

Population standards, however, help distinguish urban places and rural places. In general, all communities in the United States with 2,500 or more people, and smaller communities near big ones, are considered urban. Farms, and communities in uncrowded areas with fewer than 2,500 people, are considered rural. The population standard varies among other nations of the world, and ranges from about 2,500 to 10,000 people for urban places. The United Nations considers as urban only those communities that have a population of 20,000 or more.

This article explains how cities began and developed. It describes cities and city life throughout history. It also discusses urban problems, cultural groups in cities, and cities of the future.

How cities began and developed

Human beings have probably lived on the earth about 2 million years. But they began to live in permanent settlements only between 13,000 and 10,000 years ago. Before this time, people wandered from place to place, hunting animals and gathering plants for food. But eventually people noticed seasonal supplies of fish and plants in certain regions. They remained near the avail-



Terry Farmer, Tony Stone Images

City governments provide such services as fire fighting and sewage disposal for the people of their cities. The photograph above shows a meeting of the city council of Springfield, Ill.

The 100 largest urban centers in the world

A city is defined by specific political boundaries. However, the people, businesses, and organizations that participate in the life of a city frequently extend well beyond these boundaries. The population within a city's political boundaries often represents only a fraction of the total urban population of the area.

This table presents the world's largest urban centers. It defines an urban center as a city surrounded by a continuous built-up area having a high population density. Statisticians at the United Nations determined the boundaries of the urban centers by examining detailed population maps, disregarding political boundaries. Population totals are based on estimates of increase for each urban center between the most recent census year and 2001. In other articles in *World Book,* city populations reflect the official statistics reported by each country.

Urban center	Population	Urban center	Population
1. Tokyo, Japan	28,140,000	51. Qingdao, China	4,585,000
2. Mumbai, India	18,578,000	52. Yangon, Myanmar	4,585,000
3. Mexico City, Mexico	18,194,000	53. Algiers, Algeria	4,584,000
4. São Paulo, Brazil	17,913,000	54. Philadelphia, United States	4,420,000
5. New York City, United States	16,683,000	55. Pusan, South Korea	4,262,000
6. Shanghai, China	14,374,000	56. Milan, Italy	4,251,000
7. Lagos, Nigeria	14,137,000	57. Ahmadabad, India	4,250,000
8. Los Angeles, United States	13,217,000	58. Belo Horizonte, Brazil	4,225,000
9. Calcutta, India	13,135,000	59. Alexandria, Egypt	4,080,000
10. Buenos Aires, Argentina	12,547,000	60. San Francisco, United States	4,079,000
11. Seoul, South Korea	12,293,000	61. Madrid, Spain	4,072,000
12. Beijing, China	12,235,000	62. Chongqing, China	3,988,000
13. Karachi, Pakistan	12,197,000	63. Washington, D.C., United States	3,960,000
14. Delhi, India	12,008,000	64. Handan, China	3,959,000
15. Dhaka, Bangladesh	11,470,000	65. Dallas, United States	3,950,000
16. Manila, Philippines	11,108,000	66. Guadalajara, Mexico	3,948,000
17. Cairo, Egypt	10,992,000	67. Medellin, Colombia	3,913,000
18. Rio de Janeiro, Brazil	10,638,000	68. Detroit, United States	3,802,000
19. Osaka, Japan	10,609,000	69. Porto Alegre, Brazil	3,758,000
20. Tianjin, China	10,438,000	70. Ho Chi Minh City, Vietnam	3,719,000
21. Jakarta, Indonesia	10,079,000	71. Frankfurt, Germany	3,708,000
22. Paris, France	9,648,000	72. Sydney, Australia	3,683,000
23. Istanbul, Turkey	9,413,000	73. Santo Domingo, Dominican Republic	3,677,000
24. Moscow, Russia	9,299,000	74. Singapore, Singapore	3,624,000
25. Taipei, Taiwan	8,501,000	75. Casablanca, Morocco	3,622,000
26. London, United Kingdom	7,640,000	76. Pune, India	3,587,000
27. Lima, Peru	7,584,000	77. Bandung, Indonesia	3,529,000
28. Tehran, Iran	7,531,000	78. Katowice, Poland	3,500,000
29. Bangkok, Thailand	7,363,000	79. Abidjan, Côte d'Ivoire	3,472,000
30. Hyderabad, India	7,077,000	80. Nanjing, China	3,462,000
31. Chicago, United States	6,972,000	81. Monterrey, Mexico	3,452,000
32. Bogotá, Colombia	6,957,000	81. Riyadh, Saudi Arabia	3,452,000
33. Chennai, India	6,780,000	83. Xian, China	3,435,000
34. Hangzhou, China	6,770,000	84. Montreal, Canada	3,419,000
35. Essen, Germany	6,565,000	85. Nagoya, Japan	3,395,000
36. Lahore, Pakistan	6,250,000	86. Houston, United States	3,393,000
37. Hong Kong, China	6,119,000	87. Recife, Brazil	3,349,000
38. Changchun, China	5,816,000	88. Berlin, Germany	3,339,000
39. Shenyang, China	5,807,000	89. Addis Ababa, Ethiopia	3,269,000
40. Bangalore, India	5,703,000	89. Dusseldorf, Germany	3,269,000
41. Harbin, China	5,661,000	91. Dalian, China	3,261,000
42. Chengdu, China	5,473,000	92. Ankara, Turkey	3,253,000
43. Santiago, Chile	5,325,000	93. Salvador, Brazil	3,240,000
44. Guangzhou, China	5,298,000	94. Melbourne, Australia	3,207,000
45. Kinshasa, Congo (Kinshasa)	5,266,000	95. Caracas, Venezuela	3,189,000
46. St. Petersburg, Russia	5,132,000	96. Cape Town, South Africa	3,167,000
47. Jinan, China	5,021,000	97. Maputo, Mozambique	3,160,000
48. Baghdad, Iraq	4,917,000	98. Athens, Greece	3,105,000
49. Wuhan, China	4,860,000	99. Cologne, Germany	3,074,000
50. Toronto, Canada	4,707,000	100. Fortaleza, Brazil	3,068,000

Source: World Book estimates for 2001 based on data from the United Nations.

able food for years at a time. About 11,000 years ago, according to most scientists, people in the Middle East began to cultivate the land. These men and women, called *Neolithic people,* became the first farmers.

Between about 8000 and 3500 B.C., some Neolithic villages had developed into small cities of a few thousand people. Since these first cities appeared, people have built cities for many reasons. The cities have differed in size and layout, and they have had a variety of economic, governmental, and social systems. But all permanent settlements—from Neolithic village to giant city—needed four main features to begin and to grow. These features were (1) advances in technology, (2) a favorable physical environment, (3) social organization, and (4) population growth.

Advances in technology. The word *technology* refers to the tools, knowledge, and inventions that help people satisfy their needs and improve their way of life. Technological advances that helped cities develop include farming skills and improved transportation.

Neolithic people learned how to grow crops and invented tools that improved farming methods. Neolithic people also tamed animals, which they used for food or agricultural tasks. All these developments helped many Neolithic families produce more food than they needed.

Because of this surplus food, a number of people switched to jobs other than farming. Some became skilled at crafts and made baskets, cloth, leather goods, tools, or other products. Others became miners and dug for flint, metal, and stone. The nonfarmers traded the items they made to the farmers in exchange for food.

Through the years, people in distant cities began to trade with one another. In addition, technological advances enabled more people to become nonfarmers. They worked as warriors, record keepers, and religious and political leaders. These people founded and populated the cities of the world.

Technological advances have influenced city life throughout history. For example, the development of the steam engine in the 1700's gave people the power source they needed for large-scale manufacturing. Many cities became giant manufacturing centers partly because of this development. Sometimes industrial expansion led to the construction of new cities. In the early 1900's, the United States Steel Corporation planned and built Gary, Indiana, around the company's new mills. During the 1900's, thousands of suburbs grew up around big cities. The automobile and the railroad train—two technological advances in transportation—helped make these suburbs possible. Many people who lived in the suburbs needed cars and trains to travel to work in the cities.

Physical environment of a city includes its location, its climate, and the availability of water and food. Cities have been founded in many kinds of environments, but their development has depended on certain favorable environmental features. All cities, for instance, must have enough drinking water. Early communities, which depended on farming, needed enough rainfall to grow crops. Good soil was also essential for growing crops, and nearness to other food—animals and edible plants—was helpful. Other favorable environmental features included a reasonably mild climate and a location near materials for making clothes and building shelters.

Early people found many favorable environmental features in river valleys with hot weather. Some chose to settle in the Tigris-Euphrates Valley of what is now Iraq and the Nile Valley of what is now Egypt. Other early people settled in the Huang He (Yellow River) Valley of present-day China and the Indus Valley of what are now northwestern India and Pakistan.

Through the years, other environmental features have also helped cities develop. Since ancient times, for example, people have traveled in ships to trade with peo-


Drawing by Alan Scorell, British Crown Copyright; reproduced by permission of the Ministry of Public Building and Works, Edinburgh


The University Museum, University of Pennsylvania



Neolithic villages were the ancestors of cities. An artist's conception, *right,* shows how the Neolithic village of Jarlshof in the Shetland Islands may have looked. A wall surrounded the houses and a tall watchtower. Many people stored food in large jars. A painted storage jar, *above,* was found in Pakistan's Indus Valley. It stands about 2 $\frac{1}{2}$ feet (76 centimeters) high.

ple of other nations. Many cities that lay near large bodies of water became important trading centers. They included Istanbul, Turkey; London, England; Shanghai, China; and Venice, Italy. Chicago, in the United States, and Toronto, in Canada, developed partly because they lay along important land and water transportation routes. Many cities, including Manchester, England, gained importance as manufacturing centers because of nearby minerals or other raw materials needed for manufacturing. Some cities owe their development chiefly to climate. For example, the warm, healthful climate of parts of Florida and the Southwestern United States attracted many people.

Social organization. Certain rules of behavior are needed to maintain order, peace, and security in any community. Since Neolithic times, most people have agreed that it is wrong to steal from or harm others in their group. In turn, people expect that their own rights to safety and property will be respected by other members of the group. People also have duties toward their group as a whole. They have often fought to protect their group from enemies.

The maintenance of order in groups also requires some system of authority. In the family, the most basic social group, parents have authority over their children. In larger social groups, including cities, citizens must accept the authority of government.

Neolithic villages had a simple social organization. People were required to respect each other's rights, and children had to obey their parents. But most villages had few government officials as we think of such officials today. Someone probably took care of the surplus food, and there may have been a chief planner for defense against outsiders. As cities grew, the duties of family members and neighbors toward each other remained basically the same. But to keep order in cities, governments took on a greater role in managing community affairs and providing services for the people. Government officials organized trade, planned military action, and conducted religious worship. The number of workers employed by cities also increased. Today, these workers include mayors, city planners, garbage collectors, police officers, and teachers.

Population growth. Only about 10 million people existed at the beginning of the Neolithic Period. The population of the world reached about 500 million by A.D. 1650 and about $5\frac{1}{3}$ billion by 1990. This *population explosion* led to an increase in both the size and number of cities.

Two other trends also have aided the development of cities. One trend—sometimes called *population implosion* or *population urbanization*—is the increasing concentration of people in small parts of the earth. These parts are the cities and their surrounding areas. The other trend—sometimes called *population displosion* or *population diversification*—is the movement to cities by people of a variety of cultural backgrounds. Through the years, cities came to include people of different racial, religious, national, and language groups. This mixing of people brought about *cultural diffusion,* a process by which people of different backgrounds learn from each other by exchanging ideas. Cultural diffusion ranks among the most important factors in the development of civilization.

Ancient cities

Thousands of years passed before the Neolithic villages developed into cities. The first cities had appeared by 3500 B.C. in the Tigris-Euphrates Valley. The valley was located in the lower part of Mesopotamia, in what is now Iraq. The first Chinese cities probably began to develop by the mid-1600's B.C. Cities developed in east Africa by about 500 B.C. and in Central America by about 200 B.C.

Ancient cities differed from Neolithic villages in several ways. The cities covered more land than the villages, with large public buildings for worship and storage of grain or weapons. More people lived in cities than in villages, including more people from different backgrounds. The work of the city people also differed from the work of the village people. Almost all village workers were farmers, but most city people had nonfarm jobs. Merchants became a new group of workers in early cities, and the number of craftworkers and government officials continued to grow.

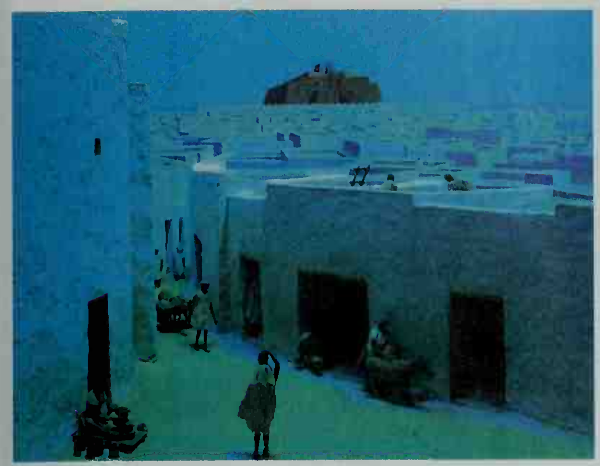
Description. An early ancient city covered less than 1 square mile (2.6 square kilometers). Most of its people lived near the city's water supply because they had to get their own water and carry it home themselves. Technological advances enabled some ancient cities to grow. Rome, for example, built structures called *aqueducts* for transporting water over long distances and grew to more than 4 square miles (10 square kilometers).

Many ancient cities had walls surrounding them for protection against enemies. Hills also helped protect some ancient cities. Rome was built on hills, and Athens was built around a hill where the people could go if enemies attacked the city. The central area of most cities included a place of worship, the ruler's palace, and a storehouse for food. In some cities, a wall surrounded this central area to keep out both enemies and hungry citizens. Houses stood crowded together around the central area.

Sanitation presented a major problem in ancient cities, most of which had no system for getting rid of wastes. The people simply threw garbage and other wastes into the streets or piled them up outside the city wall. As a result, disease spread quickly and death rates were high. The narrow, unpaved streets often turned into seas of mud when rain fell.

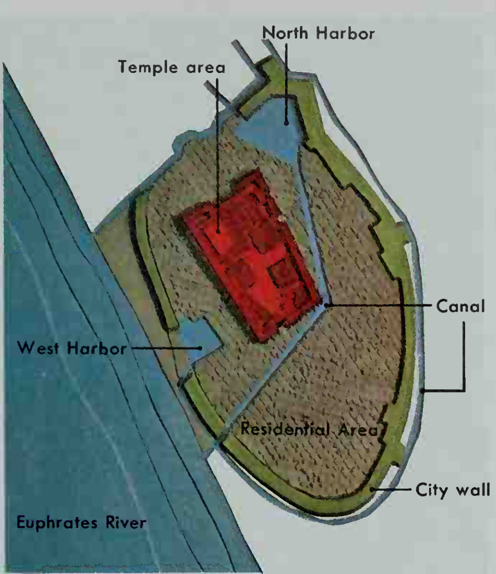
Some ancient cities reached a more advanced degree of development. Rome, for example, had a sewer system and a water supply system. Teotihuacán, in what is now Mexico, contained a planned street system and apartment buildings. Other advanced ancient cities included Athens, Babylon, and several cities of Egypt. See **Athens; Babylon; Egypt, Ancient; Jerusalem; Maya** (The Classic Period); **Rome.**

The people. Ancient cities had more people than did Neolithic villages but far fewer than cities of today. Most of the cities had populations of under 10,000, though other cities were much larger. For instance, Athens,



© American Museum of Natural History

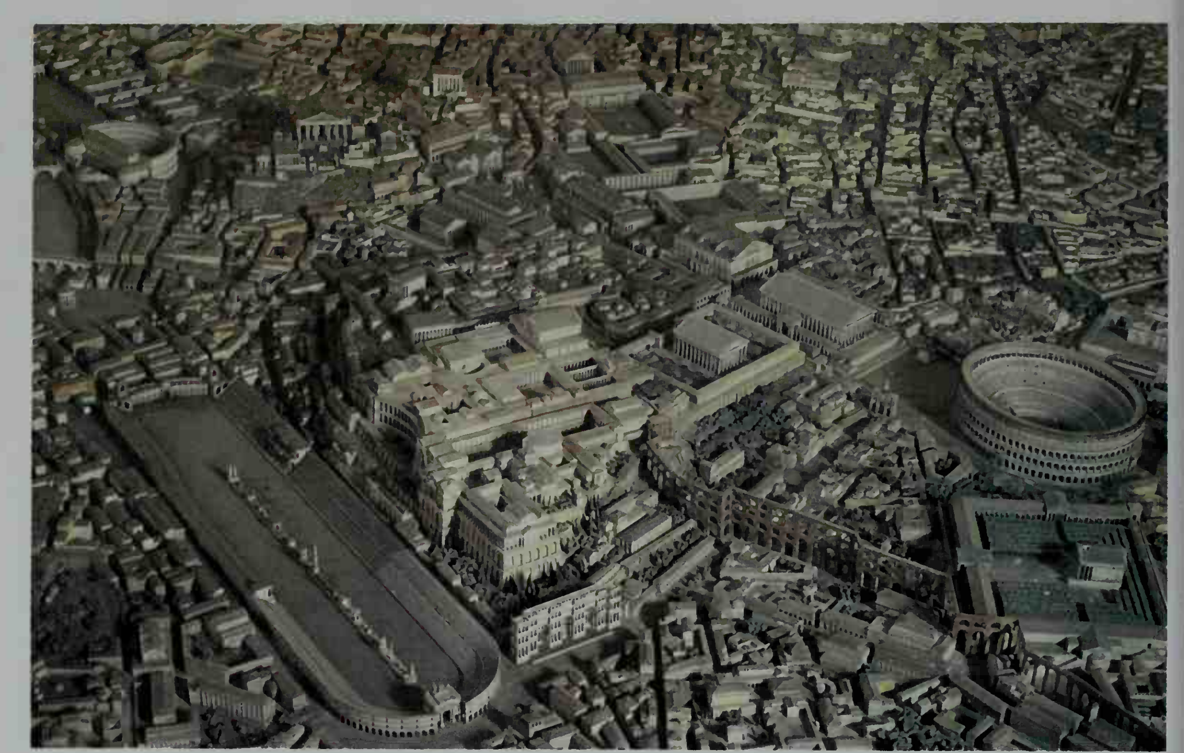
Ur was one of the first cities. The Sumerians founded it about 3500 B.C. in what is now Iraq. They built a *ziggurat* (temple), *background above,* in the shape of a mountain—perhaps because they once worshiped on mountaintops. The plan of Ur is shown at the right.



WORLD BOOK illustration by George Suyeoka

Drawing (1908) by A. Zippelius; Deutsches Archäologisches Institut, Istanbul

Priene, an ancient Greek city, lay in what is now western Turkey. The wall around the city helped keep invaders out. The marketplace, consisting of long, narrow buildings and a large yard, dominated the center of Priene. Government buildings, houses of worship, and an outdoor theater stood nearby. A huge gymnasium and a stadium stood along the near wall. The houses, as in many cities today, were laid out in rectangular blocks.



Savio Oscar Fotografo

Rome, one of the largest ancient cities, reached a size of more than 4 square miles (10 square kilometers) and a population of nearly 1 million. Aqueducts carried water from mountain springs. One of these long wall-like structures appears at the lower right of the model of Rome above. Rome had huge public buildings. These included the oblong Circus Maximus, *left,* and the circular Colosseum, *right,* where people were entertained, and many government buildings.

Greece, had about 25,000 people in 1200 B.C. Its population reached about 155,000 by 430 B.C.

The first peoples of the first cities formed *homogeneous societies.* That is, they had the same racial and geographic backgrounds and shared the same religious beliefs and other cultural characteristics. But the cities soon began to draw people from a variety of backgrounds. Many people moved from the countryside in search of a better life in the city. Others had been captured in war and were brought to cities to serve as slaves. The arrival of newcomers gave the cities *heterogeneous societies,* made up of people of many different backgrounds.

The formation of heterogeneous societies caused cultural diffusion, but it also had undesirable effects. In many cities, the original group and the newcomers distrusted each other. Their distrust often led to *discrimination,* the unfair treatment of people from different cultures.

The people of ancient cities were divided into classes. The upper class included government and military officials, rulers, and high priests. The lower class consisted of farmers, craftworkers, and merchants. At the bottom of society were the newcomers, especially slaves and people from greatly different backgrounds than those of the native citizens. The newcomers were called *outcasts,* and most of them were forced to live in separate areas of the cities. The outcasts had the poorest housing, little food and clothing, and no education.

Upper-class families lived in large houses. Most other people lived in small one- or two-room houses. In many families of all classes, children, parents, grandparents, and other relatives lived in the same house.

In most ancient cities, only boys from upper-class families got a formal education. Other boys learned a craftworker's trade—usually that of their father—or received no education at all. Girls of all classes learned various household duties from their mothers.

Most people worshiped a number of gods. Many thought that angry gods caused personal misfortune. Festivals were held to honor and to please the gods. Many ancient peoples, including the Egyptians, Greeks, and Romans, built beautiful temples and monuments and dedicated them to the gods. Some Indians of Central and South America also followed this practice. For example, ancient Indians constructed the famous religious buildings at Monte Albán, in what is now Mexico.

Economy. Just as technological progress in agriculture had made Neolithic villages possible, further advances in farming spurred the development of ancient cities. The invention of new farm tools and the discovery of new methods of cultivation, irrigation, and animal raising helped increase food surpluses. As the surpluses increased, more people stopped farming and went to cities in search of other work.

Craftworkers became an important group in the cities. The first craftworkers wandered from place to place because no one community had enough work for them.

But as cities grew large enough to support them, craftworkers began settling permanently.

The first craftworkers sold the products they made. Later, city life grew more complex and a new group of working people, the merchants, appeared. This group sold the products made by others.

The merchant class was a result of technological advances in transportation. The wheel, invented in the Tigris-Euphrates Valley about 3500 B.C., gradually came into general use during ancient times. Wheeled vehicles and vastly improved roads enabled people to move large amounts of goods within cities and from city to city. Improvements in water transportation enabled merchants to trade their goods both in nearby places and in distant lands. Foreign trade became important to the economy of some ancient cities. For example, trade networks connected cities throughout the Middle East with cities in northern and eastern Africa. The Phoenicians played a leading part in the development of trade over large bodies of water. The Phoenician city of Tyre became an important shipping port (see **Phoenicia**).

Government. Religious leaders performed most duties of government in the earliest communities. The people believed that their leaders' authority came from the gods. Therefore, the leaders were responsible to the gods, not to the people. As communities developed, emperors, kings, and other nonreligious rulers took over the power to govern. These rulers developed laws that could be enforced by military and police power. But many people still believed that the right to govern came from the gods. As a result, rulers had both the divine right to rule and the civil power to enforce laws.

Local administrators from the upper class governed most ancient cities. They were responsible to the emperor, the king, or some other higher authority. Some cities, including Athens, were independent of any higher authority. Their rulers governed the city and its outlying area. Such regions were called *city-states* (see **City-state**).

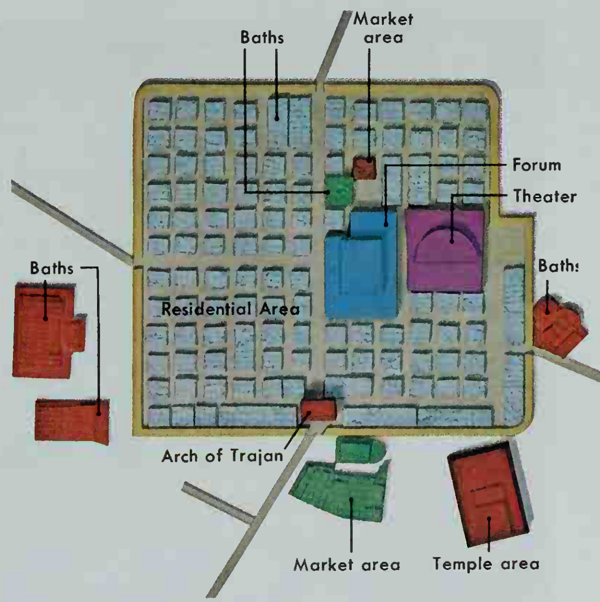
The local rulers taxed the craftworkers, farmers, and merchants heavily to pay the costs of operating the government, constructing public buildings, and carrying out other projects. The people had little or no voice in the government. Athens and some other Greek city-states were important exceptions. In those communities, all adult males who were not slaves helped determine government policy. See **Democracy** (Origins of democracy).

Medieval cities

The Middle Ages began after the fall of the Roman Empire in the A.D. 400's and lasted until the 1500's. The Roman Empire ruled a vast region that, at its height, included most of Europe, the Middle East, and the northern coastal area of Africa. Rome was its capital.

The Romans helped build cities throughout their empire. They also built a network of roads that served as trade routes between the cities. The empire declined during the 400's, and Germanic tribes conquered it and divided it into many kingdoms. These tribespeople were

Brian Brake, Rapho Guillumette



WORLD BOOK illustration by George Suyeoka

Timgad, part of the giant Roman Empire, was built about A.D. 100 in what is now Algeria. Military engineers planned Timgad and many other cities in the empire as camps for Roman soldiers. The ruins of Timgad, *left,* and a plan of the city, *above,* show the orderly arrangement of buildings and streets that was typical of the work of these military planners.

warriors, hunters, and farmers with little interest in trade. After the fall of the Roman Empire, trade among European cities almost stopped. Thousands of people left the cities and went to work on farms. Between the 400's and 1000's, the populations of existing cities decreased and few new cities appeared. Trade regained importance after about 1000, and cities began to grow again.

Description. Many European medieval cities had a similar layout. A typical city covered less than 1 square mile (2.6 square kilometers) and had walls around it for protection against invaders. The city's main church—in many cases a magnificent, towering Gothic cathedral—stood in the central area. The church was the city's biggest and most expensive building and a symbol of the medieval emphasis on religion. The chief government buildings and the marketplace were near the church. Wealthy people lived near the center of the city, and the poor lived away from this area. Some poor people lived in huts outside the walls.

Medieval cities, like ancient cities, were dirty and unhealthful. Disease spread rapidly, partly because the people had no sanitary method for disposing of garbage and other wastes. From time to time, disease wiped out a large part of a city's population.

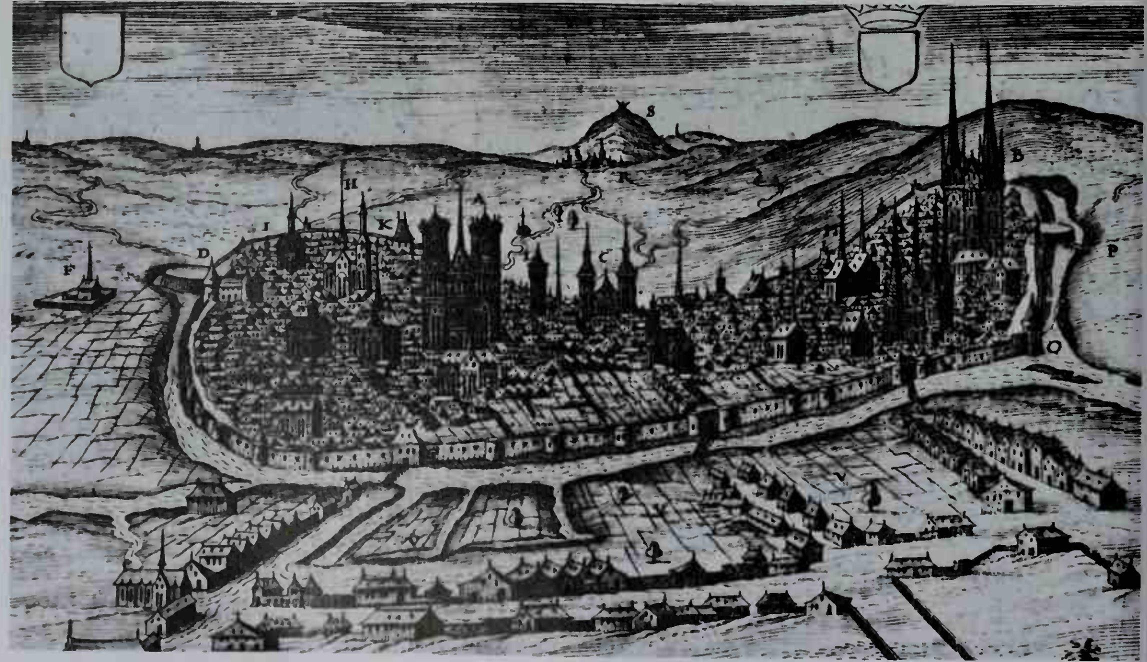
The walls around medieval cities limited the amount of living space. Land was expensive, so people began to construct five- and six-story buildings. Overcrowding became a problem during the late Middle Ages. Some cities solved this problem by knocking down the walls and rebuilding them farther out. Florence, in Italy, increased its size three times in this way. Other cities let their walls stand but built new cities nearby.

Scholars believe that Eastern medieval cities had the same general layout as European cities. But Eastern trade did not decline, and many Eastern cities were large and prosperous throughout the Middle Ages. African cities also continued to grow, and their trade networks extended to people in nearby forests and to Middle Eastern merchants. Such American Indian cities as Tenochtitlan in what is now Mexico and Cusco in modern-day Peru prospered until the 1500's.

The people. Many medieval cities contained only 300 or 400 people. Even Lübeck, Germany, an important city in northern Europe, had a population of only about 10,000 during the 1200's. In that same period, London, with about 40,000 people, Venice, with about 100,000, and Paris, with about 150,000, ranked among the biggest cities in Europe. Many Asian cities had more people. In the mid-1200's, Hangzhou (also spelled Hang-chou), China, had a population of about 320,000. Guangzhou (also called Canton), China, had about 250,000 people.

European medieval cities attracted people from a variety of backgrounds. But the people tended to settle in *quarters* (neighborhoods) with people of their own group. Some quarters resembled separate cities. They had their own markets, water supplies, and churches or synagogues. The system of separate quarters helped limit conflicts between various groups, but it also limited the exchange of ideas. Some quarters, called *ghettos,* were used to persecute certain groups. For example, many cities in Europe forced Jews to live in ghettos and to pay extra taxes.

Upper-class medieval people lived in large houses that had separate rooms for bathing, cooking, eating, sleeping, and religious and social activities. Most



Etching (1600's) by an unknown artist; Bibliothèque Nationale, Paris

Medieval Europe had many small, walled cities. Magnificent churches rose above the other buildings, symbolizing medieval society's emphasis on religion. The Cathedral of Notre Dame in Reims, France—marked "A" above—was one of the biggest, most beautiful medieval buildings.



Illustration from an illuminated manuscript (1500's) by an unknown Flemish artist; The Bodleian Library, Oxford, England

Cities in Flanders—including Bruges, *left,* and Ghent, Liège, and Ypres—grew prosperous from trade during the Middle Ages. Flemish merchants shipped large quantities of wool across the North Sea to England. They also carried on a heavy overland trade in France, Germany, and other countries. Flanders was sometimes called the marketplace of Europe.

Engraving from *L'Ambassade de la Campagnie Orientale* by Pierre de Goyer and Jacob de Keyser; Newberry Library, Chicago

Many Eastern cities prospered, even while European cities were struggling to survive in the early Middle Ages. Guangzhou (also called Canton), China, *above,* was among the busiest medieval trading centers. It became one of the first Eastern cities to trade with the West.

people in the middle and lower classes continued to live in homes with one or two rooms, which they used for all purposes. Few people in a medieval city had much comfort or privacy.

During the Middle Ages, children, parents, grandparents, and other relatives continued to live in the same house. Some medieval households also included servants and workers associated with the family's economic activity. For example, some young people worked as personal servants to nobles and lived in the nobles' houses. Many *apprentices* (young people learning a craft) lived in the homes of the skilled workers who taught them.

Religion played a vital role in medieval life. Major religions included Christianity in Europe, Islam in the Middle East, and Buddhism and Hinduism in the East.

In Europe, the Christian church had great influence. Church officials owned much land and could tax the people. The church also performed such important activities as baptism, marriage, and burial services. The church could ban people from religious services through its power of *excommunication.* An excommunicated person was a public disgrace. In addition, people who did not belong to the Christian church were often treated harshly. For example, Jews in the Christian cities of medieval Europe suffered much persecution.

In the late Middle Ages, the Christian church also influenced religious life in the cities of Africa, North America, and South America. Missionaries from Europe traveled to these continents and converted many of the original inhabitants to Christianity.

As in ancient times, formal education was largely restricted to boys of the upper class. In Europe, the Christian church played an important part in medieval education and ran most of the schools. Priests taught in these schools and also in many government schools.

Economy. During the Middle Ages, much land in Europe was divided into large rural estates called *manors.* Lords and bishops owned most of the land, and peasants farmed it for them. This economic system, called *manorialism,* began to decline during the 1000's. Many peasants began moving to cities to earn a living. Some became merchants or craftworkers. Others farmed land outside the cities and helped supply food to the city dwellers.

The growth of trade played the leading part in the economic progress of medieval cities. Trade had declined after the fall of the Roman Empire. But Venice, an Italian city, traded with Constantinople (now Istanbul), Turkey, throughout the Middle Ages. Venice remained prosperous even after other European cities declined. After those cities began to grow again, Venice traded with them. These less prosperous cities also traded with one another. The increased trade brought further growth and prosperity to European cities.

In addition to Venice, several European cities played an important part in the economic revival. They included Genoa and Pisa in Italy, Bruges in Flanders, and the

Illustration from an illuminated Latin manuscript by an unknown artist (1300's); Bibliothèque Nationale, Paris





Trade fairs were held each year in many European cities during the Middle Ages. Merchants traveled from fair to fair, buying and selling goods and exchanging ideas about new products and production methods. In the scene at the right, a bishop blesses a trade fair while merchants discuss prices and a man on horseback prepares to amuse fairgoers with acrobatic tricks. Trade fairs became part of the general revival of trade that spread through Europe after about 1000. This revival helped cities prosper and grow. Most European cities had lost importance and stopped growing after the Roman Empire fell and trade almost stopped in the late 400's.

French cities of Nantes, Orleans, Paris, and Rouen. Other important trading centers were Antwerp in what is now Belgium, and Cologne, Hamburg, and Lübeck in what is now Germany. The Chinese cities of Guangzhou, Hangzhou, Kaifeng, Beijing (also called Peking), and Suzhou (also spelled Su-chou) became leading Asian centers of trade.

Technological advances also aided the economic progress of medieval cities. New products included barrels and tubs, gunpowder, mechanical clocks, paper, printing presses, and soap. The use of water and wind power to make products increased production, thus raising standards of living and stimulating city growth. The invention of the printing press about 1440 enabled people to receive information about business and government more quickly than ever before. Newspapers and printed books increased the exchange of ideas among people.

Craftworkers and merchants benefited greatly from the economic progress. Craftworkers could make more goods—and merchants could sell more products—because of expanding trade and technological advances. The new prosperity drew even more people to the cities, providing additional markets for the craftworkers and merchants.

The craftworkers and merchants formed a new economic class—the middle class. To ensure their continued prosperity, they established organizations of workers called *guilds.* There were guilds for merchants and craft guilds for bakers, brewers, goldsmiths, tailors, weavers, and other workers. By banding together, the guild members increased their profits. In groups, they could buy large quantities of materials and goods at low prices. The guilds allowed only their members to make and sell products. They kept memberships from growing too large so each member could prosper. See **Guild.**

Government. A system of government called *feudalism* developed in Europe during the Middle Ages. The feudal system divided kingdoms into sections called *fiefs,* each ruled by a lord or bishop. Feudalism weakened the power of kings because a king ruled only the land he owned, rather than an entire kingdom. Cities were governed by the lord or bishop who owned the land on which they stood. See **Feudalism.**

As cities gained importance during the 1000's and 1100's, many city people began to resent the interference of lords and bishops in local affairs. Led by the merchant and craft guilds, citizens fought for the right to govern themselves.

Numerous cities succeeded in their struggle for self-government, though women and many other groups could not participate. In Milan and other Italian cities, male citizens won the right to elect *consuls* (officials who ran the city government). The practice of electing consuls then spread to other parts of Europe. Cities in Flanders and northern France achieved a high degree of independence. The citizens made their own laws and elected their own officials. Guild members ran many of the cities. Some kings supported the people in their fight for self-government because strong city governments weakened the power of the lords and bishops.

During the 1400's and 1500's, many kings gained power over large regions. They set up strong central governments, which reduced the power of cities.

In the East, government remained centralized throughout the Middle Ages. The king or emperor appointed local officials, who had to prove their leadership capabilities. In China, a candidate for office had to pass a civil-service examination. Government inspectors oversaw the performance of appointed officials.

Industrial cities

Between the 1500's and the 1700's, cities throughout the world grew and gradually changed. But the basic pattern of cities and city life remained much the same until the 1700's and early 1800's, when a period of rapid industrialization called the Industrial Revolution took place. During this time, many cities in Europe and North America changed greatly. These communities—called *industrial cities*—became centers of large-scale manufacturing. The manufacturing boom resulted chiefly from the invention of steam engines and new machines. The machines could do the work of many people, and the steam engine easily powered the machines as well as railroads and ships. The expansion of trade among the nations of Europe and North America also aided the growth of manufacturing. See **Industrial Revolution.**

The Industrial Revolution caused dramatic changes in city life. Skilled craftworkers had trouble finding work because machines could make the same products quickly and cheaply. Instead, people in many cities worked in large factories, lived near the factories, and depended on manufacturing jobs for their livelihood. They were often overworked and poorly housed, though living conditions improved during the 1800's and early 1900's. Even people in cities with few factories became dependent on manufacturing. They often sold materials to the industrial plants or shipped finished products abroad.

The Industrial Revolution had little immediate effect on cities outside Europe and North America. But in the late 1800's and 1900's, many cities throughout the world became involved in the growing networks of manufacturing and trade created by industrialization. Some cities of Africa, Asia, Australia, and South America became industrial centers, though others have never industrialized.

Description. Some industrial cities developed from medieval cities. When a city became too crowded, the walls were knocked down and the city expanded. Other industrial cities grew up where there had been a fort, a trading post, a village, or open land. Development in open areas occurred most commonly in North America.

Factories, warehouses, and railroad yards stood near the center of an industrial city. Nearby, poor people lived in cheap houses and apartment buildings. The poor had no means of transportation, and so they needed to live within walking distance of their jobs. As cities grew, the central areas became crowded and unhealthful. Many wealthy merchants and factory owners built big houses in the outer sections of the city. They used horse-drawn carriages for travel to the central

area. In the 1800's, some people began to move to communities just outside the city, called *suburbs*. They rode to work on railroads or streetcars. See **Suburb.**

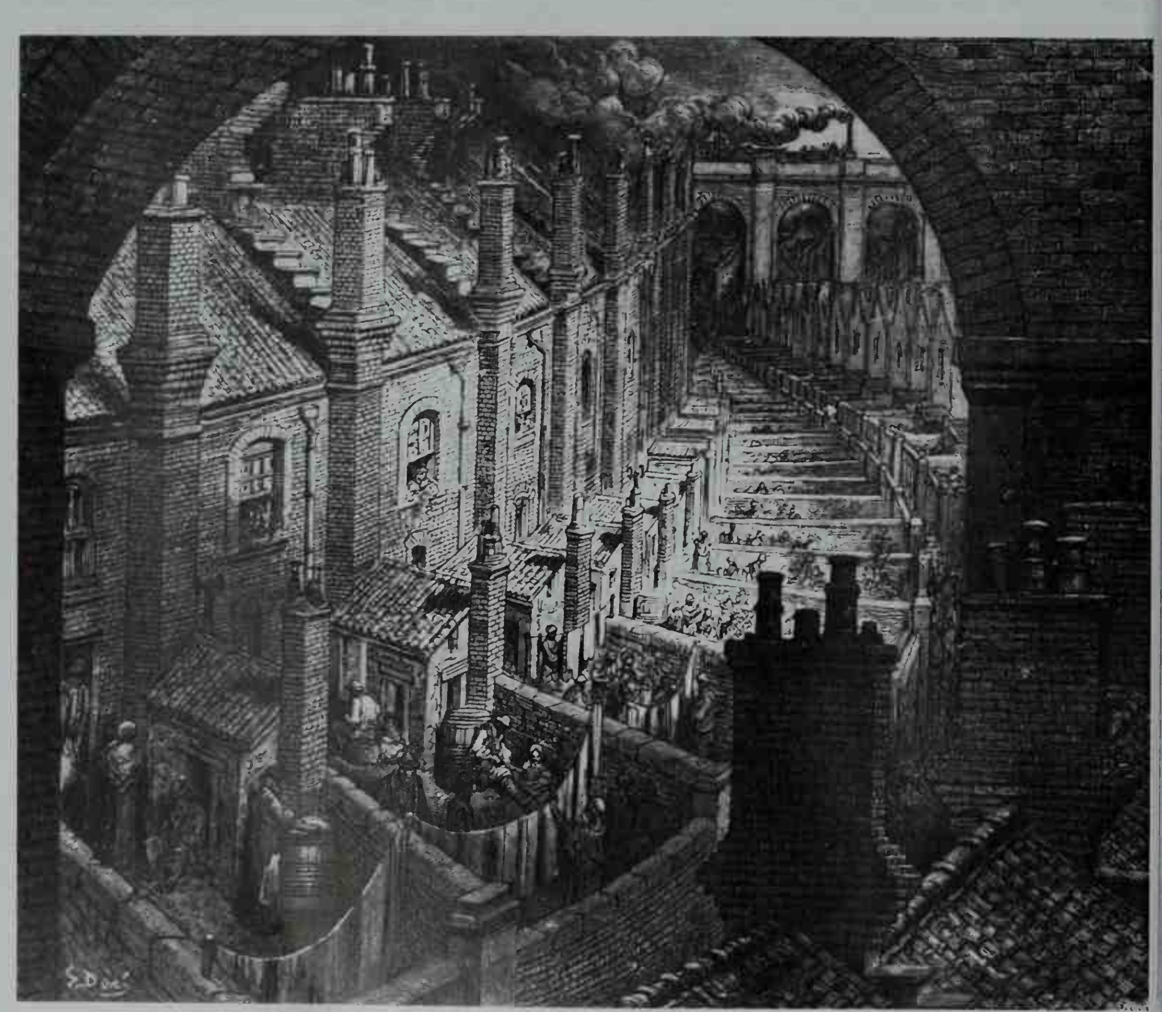
Industrial cities had sanitation problems similar to those of earlier cities. Garbage and other wastes produced health hazards because of inadequate sanitation systems. In addition, a new problem—pollution from industry—became a health hazard. Factories polluted the waterways with chemical wastes and polluted the air with harmful gases. They also created huge dumps of garbage, rusting metals, and other wastes.

The *gridiron pattern* of city blocks, which remains common today, came into widespread use in industrial cities. In this pattern, buildings are spaced more or less evenly apart, and groups of them form rectangular blocks. Streets, generally of the same width, separate the blocks from each other. Most earlier cities had a more irregular arrangement of buildings and many winding streets. The regular pattern made it easy to extend a city in any direction. But it also gave a city a monotonous appearance.

The people. City populations increased greatly during the Industrial Revolution for two main reasons. First, the population of the world was increasing faster than ever before. Second, improvements in agricultural methods had reduced the need for farmworkers. These workers flocked to the cities and took jobs in factories.

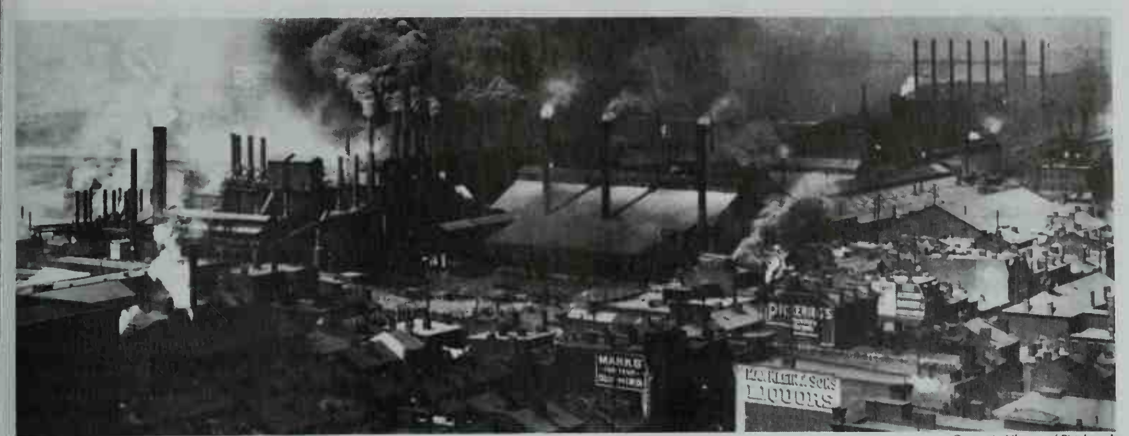
Chicago and Manchester, England, provide two examples of the tremendous growth of industrial cities. Manchester's population grew from about 6,000 in 1685 to about 303,000 in 1851. Chicago's population jumped from about 4,000 in 1840 to more than 1 million in 1890.

In the early years of the Industrial Revolution, most city people lived under miserable conditions. Men and women—and even many children—worked 12 or more hours a day in dark, dirty factories. They held monotonous, tiring jobs, such as tending a machine or carrying heavy materials. The factories had few safety rules, and



Engraving (1872) by Gustave Doré; The Mansell Collection

The Industrial Revolution increased the production of goods, but it also brought miserable living conditions at first. Farm people in Europe and North America flocked to cities to take newly created jobs in factories. But like the Londoners above, most of them lived crowded together near the factories.



Carnegie Library of Pittsburgh

Factories, such as those in Pittsburgh, *above,* turned out products quickly and cheaply. Factory workers, underpaid at first, later shared more in the profits that resulted from the factory system.

accidents killed or injured many workers.

The workers earned barely enough money to feed themselves and their families. During economic slumps, factories laid off large numbers of workers who had nowhere to turn for relief. They could no longer farm the land for food, and governments had not yet begun to provide relief for the needy. Sometimes workers organized protests against their living conditions.

The workers lived in poorly built, dirty *tenements* (crowded apartments), *row houses* (groups of houses without space between them), and cellars. In 1842, for example, about a fifth of the people in Liverpool, England, lived in cellars. The early industrial cities had widespread disease and high death rates. Pollution filled the air and the waterways, and rats and insects spread illness. The rich and the poor alike fell victim to pollution and disease. Until the 1830's, the homes of even most of the rich lacked plumbing for toilets and bathtubs. Most workers did not have these facilities until the late 1800's or the early 1900's. In the industrial cities of some developing nations, many workers still do not have indoor plumbing.

In time, the standard of living in most industrial cities improved. The mass production method used in the factories reduced the cost of making goods and thus cut the cost of the goods to customers. Many factory workers formed labor unions and threatened mass strikes to support their demands for higher wages and better working conditions. Finally, governments passed wage and welfare laws that helped the workers. The governments also took steps to improve sanitation.

A small percentage of people had great wealth throughout the Industrial Revolution. Factory owners made huge profits from the business boom and paid their workers little. Bankers and financiers invested money in the new industries and made big profits on their investments. Merchants sold more and more goods as city populations grew. These rich people lived in large houses and could afford many luxuries.

During the 1700's and 1800's, charitable organizations and governments started tuition-free schools in many



Aerofilms

Letchworth, England, *above,* was designed in the early 1900's along principles laid down by Ebenezer Howard. Howard and many other people tried to eliminate the crowded, dirty conditions of industrial cities. The plans for this town near London called for open space and for the separation of industrial and residential areas. Howard's ideas influence city planners today.

cities. These schools gave some poor children a chance to have a formal education. But many of the teachers lacked good training, and the schools often did not have enough textbooks. Also, many children could not go to school because they had to support their families. Children from wealthy families attended private schools or studied in their homes under tutors.

As in medieval times, the cities included people from a variety of backgrounds. People still tended to settle in neighborhoods with others of the same background. But various groups had much more contact with each other than they had in medieval cities. People from all groups worked together in factories, and children from many groups attended schools together. The influence of the family on the behavior and ideas of the individual remained strong. But the influence of people outside the family—fellow workers, friends, teachers, and others—increased greatly.

Economy. The flow of workers from farms to cities rose tremendously during the Industrial Revolution. The manufacturing boom provided more jobs in cities than ever before. At the same time, technological advances in agriculture reduced the number of jobs available on farms. The invention of the reaper, for example, enabled one farmer to do the work of many.

Large numbers of craftworkers became unemployed or went to work in factories. Craftworkers made their products slowly and usually used hand tools. But factory workers could make many of the same products with machines. These mass-produced goods were easier to make, and they could be sold more cheaply than the craftworkers' goods. Many craftworkers found that they could not compete with the factories, and they were forced out of business.

The factory system of manufacturing began the greatest economic boom in history. With machines, people turned out products more quickly and cheaply than ever before. The savings in production costs—together with fairer policies toward workers—resulted in greater earnings for workers. As their earnings increased, workers could buy more goods. The increased demand for goods led to increased production. Businesses built new factories and expanded existing ones. The new business created jobs for more people, and the new jobs meant that people had more money to spend. Thus, the demand for products increased again. This process of economic expansion is still going on.

Technological advances in transportation and communication aided the economic boom. The development of the steam-powered railroad train in the early 1800's gave businesses a way to send extremely heavy loads of products and raw materials over long distances. The railroad became—and remains—the chief method of transporting goods across land. The invention of the telegraph about 1837 and the invention of the telephone in 1876 made communication more efficient than ever before. With these inventions, buyers could send and receive orders for goods more quickly than by using the mail.

Business executives had to spend enormous amounts of money to obtain raw materials, build factories, and make and operate machines. The cost was met in part through the use of the economic system called *capitalism.* Under this system, bankers and private investors put up money to help pay for business operations. Their investments entitle them to share in the business profits. In early industrial cities, only the wealthiest people could invest in businesses. But as time went on, many more people took part in the system.

Government. The rapid growth of city problems during the 1700's and 1800's forced governments to take steps to improve city life. Governments of some industrial nations passed laws during the late 1800's and early 1900's that were designed to help workers. These laws included measures that regulated child labor and provided income for injured workers and for families of workers who were killed on the job. Other laws improved public health care and provided food and shelter for the unemployed.

In most countries, the central government passed the laws that benefited city people. In the United States, the federal government generally left city affairs to the state governments. Reform bills had to be approved by the state legislatures. But the majority of the legislators represented farmers and business owners. For this reason, reform for U.S. cities often came about slowly.

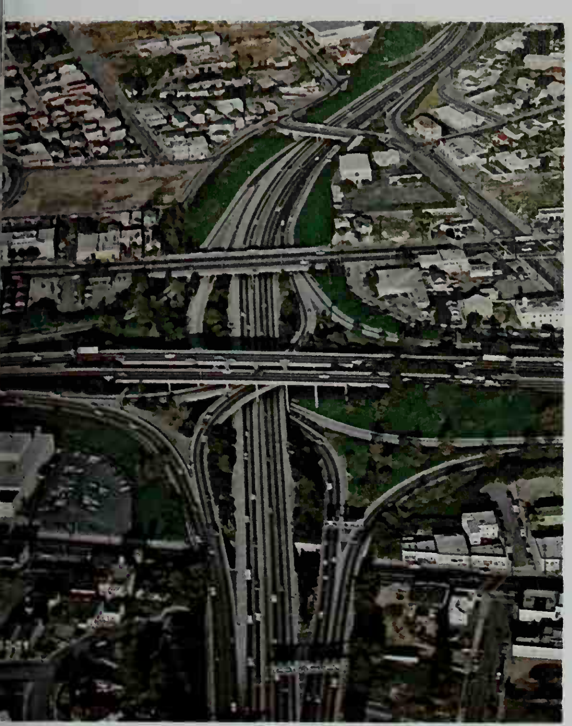
Metropolitan cities

Cities grew more than ever during the 1900's. By the end of the century, about 2,900 cities had more than 100,000 people, and about 225 cities had over 1 million people. Mumbai, one of the world's largest cities, has a population of about 11 million. New York City, the largest city in the United States, has about 8 million people.

Even more striking growth has taken place in suburban areas. Large numbers of people have settled in suburbs since 1900. The great masses of people that had filled the cities are now crowding both the cities and the land that surrounds them. Besides homes, many suburbs today contain offices and shopping centers. Suburban residents can work and buy the goods they need without traveling to the city.

A city with suburbs is a *metropolitan city,* and the city and the developed area around it is a *metropolitan area.* The word *metropolitan* comes from Greek words meaning *mother city.* The São Paulo metropolitan area is one of the largest metropolitan areas in the world. It has almost 18 million people. The largest cities are all metropolitan cities. See **Metropolitan area**.

The population explosion has played an important part in the development of metropolitan areas. By 2000, the world's population was more than five times as large as it was in 1850. This rapid growth led to overcrowded cities, causing large numbers of people to move to outlying areas. The population implosion, in which people moved from rural to urban areas, also helped build up metropolitan areas. The population displosion, in which people of various racial, religious, and national backgrounds moved into cities, was an important trend in the growth of metropolitan areas. After poor people moved into central cities, many wealthy people moved



California Division of Highways

A metropolitan city is a giant community with suburbs nearby. In Los Angeles, *above,* and other American metropolitan cities, expressways connect the center of town and surrounding communities. These high-speed highways enable millions of people to travel from their homes in the suburbs to their jobs in the city.

out of the cities and into the suburbs.

In addition, economic growth aided the development of metropolitan areas. The booming economies of industrial nations helped millions of people achieve a high living standard. As a result, more people could afford expensive homes in the suburbs. In many nations, governments helped pay for roads and transportation systems in new areas. People could easily travel to the city on streetcars, subways, and railroads.

Motor vehicles, a major technological advance of the 1900's, also helped metropolitan areas develop. The automobile made it possible for millions of people to live far from jobs, schools, and shopping. By the early 1990's, there were about 450 million passenger cars in the world. Motor trucks became cheaper than railroads for transporting goods over long distances. The lower costs encouraged many factories and stores to locate in the suburbs.

Description. Today's cities are much larger than those of earlier times. In the late 1400's, for example, Paris covered about 3 square miles (8 square kilometers). The city now covers 41 square miles (105 square kilometers), and its metropolitan area stretches about 185 square miles (479 square kilometers).

The layouts of most metropolitan cities in the United States resemble one another. The original business section lies downtown, in the center of the city. It contains banks, museums, government buildings, and company headquarters. People from throughout the metropolitan area work in offices there and shop in downtown stores. The business section covers a small area. But it can serve thousands of people daily because many offices and stores are in large skyscrapers.

In the past, most business people worked downtown and lived nearby. But many metropolitan areas today are *decentralized.* They contain various centers of business and housing in addition to the original city center.

An industrial region of factories, warehouses, and shipping yards lies next to or encircles the downtown section of many cities. The residential areas, where most of the people live, begin beyond the industrial region. The oldest and most run-down houses are in the residential area closest to the city center. Most of the city's poor people live in this area, often called the *inner city.* In the mid-1900's, local and federal governments began urban renewal projects in many inner cities. These projects replaced some of the worst buildings with new, low-cost housing. In the United States, a large portion of this new housing consisted of high-rise apartment buildings.

The neighborhoods become newer away from the inner city, and the newest homes stand in the distant suburbs. Each residential area has its own stores or other businesses. In the suburbs, shopping centers may contain many stores—and several restaurants and movie theaters—in one building.

The main streets of cities and suburbs are often jammed with automobiles, buses, and trucks. At such times, traffic creeps along slowly. As a result, many wide expressways have been built to help carry the traffic. However, the number of motor vehicles has increased so greatly that traffic jams occur on expressways as well as on streets.

In the largest metropolitan areas, many people no longer spend much of their time downtown. They can live, work, shop, and find entertainment in the suburbs. In some cities, this suburban way of life led to the closing of old stores and businesses in the city center. But in the late 1970's and the 1980's, some suburbanites who worked downtown grew tired of constantly traveling between the suburbs and the city. In response, builders began to construct new luxury apartments and homes near downtown.

Many cities have a serious pollution problem. Motor vehicles, factories, and other sources create so much air pollution that it may hang in the air like dirty fog. Air pollution threatens the health of the people who live in cities. City wastes cause water pollution when they are poured into waterways. These wastes kill fish and make some areas unfit for swimming. In addition, many large cities have difficulty disposing of their refuse. The amount of refuse grows each year, but places to put it are quickly filling up.

The people. The population of urban places has continued to increase since the Industrial Revolution. Today, about two-fifths of the people of the world live in urban areas. The United States classifies about 75 percent of its population as urban. In Canada, too, about 76 percent of the population lives in urban places. Since 1945, suburban growth has been even more spectacular than the growth of cities has been. In the United States, more people now live in the suburbs than in the central cities.

On the whole, the people in the metropolitan areas of North America, Western Europe, and Japan have the highest standard of living in history. There are many more wealthy people and middle-income people than ever before.

Most of the people who live in metropolitan areas have good housing, send their children to well-equipped schools, and can afford the necessities—and many luxuries—of life. Workers in all occupations have benefited from the booming economy and from the increased strength of the labor movement during the 1900's. However, as has been true throughout history, many people live in poverty.

The existence of poverty ranks among the chief problems of today's cities. The poor are often unable to find the jobs they need to better themselves. They may lack the education or training to help them find good jobs. Discrimination on the basis of race, religion, sex, or nationality also limits opportunities for many people. In the United States, targets of discrimination in the 1800's and early 1900's included the Chinese, Irish, Italians, Jews, and Poles. Blacks, Hispanic Americans, American Indians, and Asian Americans are among the many groups that still suffer from discrimination in U.S. cities.

Many poor people live in the inner city. This area is characterized by run-down apartment buildings that are crowded and close together. Many of the apartments have been divided, so that more than one family lives in quarters originally intended for a single family.

A large percentage of the people in neighborhoods just beyond the inner city are classified by sociologists as lower middle class. These people live more comfortably than the poor people but not nearly so well as the people farther out. Most of the houses are old and small. But they are in better condition and are less crowded than housing in the inner city.

Most middle-class and wealthy people live on the edges of the city or in the suburbs. However, some live in apartment buildings downtown. Their homes are bigger and newer than those in the inner city. Many houses have large backyards where families can play and relax in privacy.

Since the mid-1900's, the movement to the suburbs has increased dramatically. People move out to find better housing and cleaner, quieter, and safer living conditions. They seek a better education for their children than that available in the inner city. Many schools in the inner cities rank low on various measures of educational achievement.

Metropolitan areas are becoming more culturally diverse. People from many backgrounds live in the city and suburbs. However, residents with similar incomes, nationalities, and religions often live near each other.

Economy. The economic boom that began during the Industrial Revolution of the 1700's and 1800's is still going on, and the markets for products made in cities continue to grow. The population explosion has created more buyers for more goods, and higher standards of living make it possible for people to buy an increasing volume of products. Many nations have expanded their trade with other nations, creating new markets for their products. Technological advances have also made many new products available. The economies of advanced nations rely heavily on sales of such products as automobiles, computers, refrigerators, and television sets.

Metropolitan cities, like industrial cities, are manufacturing centers that provide jobs for thousands of factory workers. But today's cities also have large numbers of jobs for workers in hundreds of other fields. Salespeople sell the products of industry, and transportation workers move the products from place to place. Office workers help keep businesses running smoothly. Construction workers build offices, factories, and housing units.

Many people who work in metropolitan cities have jobs in *service industries,* which provide services instead of agricultural products or manufactured goods. Examples of workers in service industries include psychologists, lawyers, and secretaries. To manage the affairs of cities, governments employ such service workers as accountants, fire fighters, and tree trimmers.

Major technological advances have helped economic growth since 1900. These advances include the use of electricity and gasoline to run machines and the development of plastics and other materials to make new products. Other technological advances have been radio, TV, and the space satellite for communication; the automobile and airplane for transportation; and the computer to handle information needed by complex economies. Jobs created by technological progress include those of airplane pilots, computer operators, electricians, mechanics, and service station attendants.

Economic activity in metropolitan areas has become increasingly decentralized due to technological advances. Many business firms have built factories or warehouses in the suburbs while keeping their main offices in the city.

Government. The governments of metropolitan cities have grown into large, complex organizations. They face the challenging tasks of providing services for thousands or millions of people and of helping rebuild aging, decaying parts of cities. They are hard-pressed to obtain the funds they need to do their work, and their problems increase as urban populations continue to grow. For further information, see the *Governmental problems* section of this article.

City problems

Cities are the cultural, economic, governmental, population, transportation, and communication centers of the world. They are places where most people can find a job and earn a living and where some people can accumulate moderate or great wealth. In cities, people can also choose from a variety of cultural and recreational activities that add to the enjoyment of life. Nevertheless, cities have many physical, social, economic, and governmental problems.

Physical problems of cities include substandard housing, pollution, and traffic congestion. The term *substandard housing* refers to poorly constructed, run-down, unsanitary, or overcrowded dwellings. In developing nations, millions of people live in crude shacks or

other dwellings that barely provide shelter. The people of advanced nations are better off. Even so, some housing in advanced nations is also substandard. Many governments have set up programs to improve housing for needy families. However, population growth, lack of funds, the high cost of construction, and other factors continue to cause a worldwide housing crisis. Substandard housing and attempts to solve the problem are discussed in detail in the **Housing** article.

Motor vehicles, factories, and other sources pollute the air with fumes that endanger the health of the people in cities. Urban wastes pollute waterways. City residents and industries produce extraordinary amounts of refuse. A government might want to end pollution by eliminating sources of contamination. But the government would need to close factories and prohibit almost all automobiles to do so, thus crippling the economy and inconveniencing the people.

Instead, citizens, governments, industry, scientists, and business people must work together to gradually reduce pollution. For example, most cities have introduced recycling programs, which cut down on refuse and the space needed to store it. Residents separate recyclable products from garbage, and city governments provide drop-off sites or pick up the products from homes. See **Environmental pollution; Recycling.**

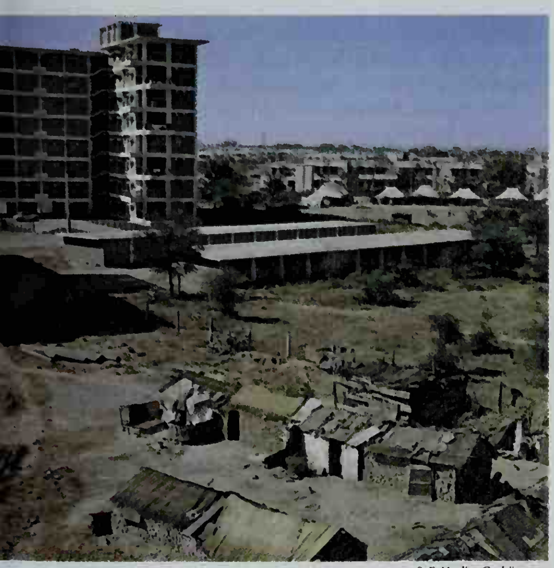
At any time—but especially during the morning and evening rush hours—the main streets of cities and suburbs can become jammed with motor vehicles. Such traffic jams delay and anger people trying to get to and from work and other places. Governments have built expressways, tried to improve public transportation, and taken other steps to relieve traffic congestion. Even so, getting from place to place in a metropolitan area continues to become more and more difficult, because of population growth and the ever-increasing use of automobiles.

Social problems in today's cities include crime, juvenile delinquency, alcoholism, drug addiction, and friction between people of different backgrounds. Poverty—which is both a social and an economic problem—is discussed in the *Economic problems* section of this article.

Crime, alcoholism, drug addiction, and juvenile delinquency do not occur only in cities. But these social problems affect many people who live in cities. Social scientists point out that some individuals come to feel they have no place in society. These individuals may turn to crime or delinquency as a way of making money or lashing out at society. Or they may seek escape from their problems through the abuse of alcohol or drugs. Young people in the inner city sometimes turn to crime or drugs because they have grown up without enough guidance from adults.

Stricter law enforcement might help reduce crime. However, the problems will reappear unless their causes are eliminated. Private and governmental organizations try to reduce social problems. These groups publicize the dangers of turning to crime, alcohol, or drugs. They also work with people to help them overcome their problems.

The population displosion has led to conflicts between groups of people. Often, groups with different cultural backgrounds fear and distrust each other and view each other's way of life as inferior. Such attitudes have caused violence between groups. Examples since 1900 include conflicts between Protestants and Roman Catholics in Northern Ireland; Hindus and Muslims in India and Pakistan; blacks and whites in South Africa and the United States; and language groups in India. In some places, governments have passed laws to protect minority groups from injustices. However, conflicts between groups will continue until people learn to live together peacefully.



S. E. Hedin, Carl östman

Substandard housing is one of the most serious city problems. Despite government efforts to improve housing, many dwellings like the shacks in New Delhi, India, shown here, remain.



Pictorial Parade

Travel in cities is often difficult. People must crowd into trains and buses and drive on jammed roads. In Tokyo, workers called *pushers,* shown here, cram passengers into the trains.

Economic problems. Most people in the cities of advanced nations enjoy a high standard of living. But even in the best times, a city has many poor people. Poverty has existed since ancient times, but the wealth of some people in cities highlights the problem. Most of the new jobs, spacious homes, and good schools are in the suburbs. Residents of the inner city cannot share in these opportunities. In some inner cities, the loss of jobs and housing has left poor people homeless. When poor people also suffer discrimination, their anger has occasionally led them to riot.

Governments, individuals, and charitable and social action organizations work to eliminate poverty. They try to improve educational and job opportunities for the needy, and they provide many poor people with financial aid. For a detailed discussion of the problem and steps taken to solve it, see **Poverty**.

Complex economic and social factors sometimes lead to business slumps. During a slump, many workers lose their jobs and the number of needy people in cities increases. The workers can sometimes collect unemployment pay from the government, but this pay is much less than their usual income. Unemployed workers cut down on their buying, and business suffers further.

Governmental problems. Through the years, the job of governing cities has become increasingly complex. Today, city governments must find ways to rebuild aging, decaying areas and to provide satisfactory schools, police protection, and other necessary services. Population growth contributes to the difficulty of governing cities. Urban governments also lack the funds that would help solve their problems.

Governments throughout metropolitan areas must provide services for populations that are continually increasing. Also, many people who move into cities are poor, and many who move out are wealthy. This development means that city governments must provide financial assistance for a larger part of the population. It also means that the people who live in the cities are less able to pay for services that are provided by the government. Wealthy people who move to suburbs may continue to earn a living in the city, but these people may no longer pay taxes to support the city's government. A city's tax base also shrinks when industries move to suburbs. State and federal governments contribute to the cost of operating cities. Even so, cities face serious financial problems.

Suburban governments also face challenging problems. They must find the money to pay for new schools and for fire and police protection. They must also install expensive sewerage and water systems.

A city government is part of a complex authority system. Each city government is subject to the regulations of its central government. In some countries, cities are also subject to the regulations of regional governments, such as those of states and provinces.

In the United States, state legislatures set up city governments to provide local services. Almost all of the states grant cities *home rule*. That is, a city may—within the general laws of the state—adopt its own *charter* (form of government) and have considerable freedom in local matters. In a state without home rule, the state legislature decides what form of government a city will have. It also decides many city government policies, such as the kind of and rate of taxation. See **Home rule**.

Many separate governmental units operate within most metropolitan areas in the United States and Canada. These units include city, suburban, county, and township governments; school districts; and special districts. Special districts include units that provide for garbage collection, mosquito control, sewage disposal, and park management. No one governmental unit has authority over the entire area. Therefore, no one unit has the authority or the responsibility for dealing with such areawide problems as pollution and the flow of mass transportation. *Metropolitan governments* have been established in a few metropolitan areas to provide an overall authority. A metropolitan government may be responsible for many services throughout the entire metropolitan area, including police protection, water supply, and mass transportation. The Miami, Florida, and Nashville, Tennessee, areas have metropolitan governments. Many people oppose this form of government. They fear that it results in higher taxes and believe only small local governments can remain close to the people.

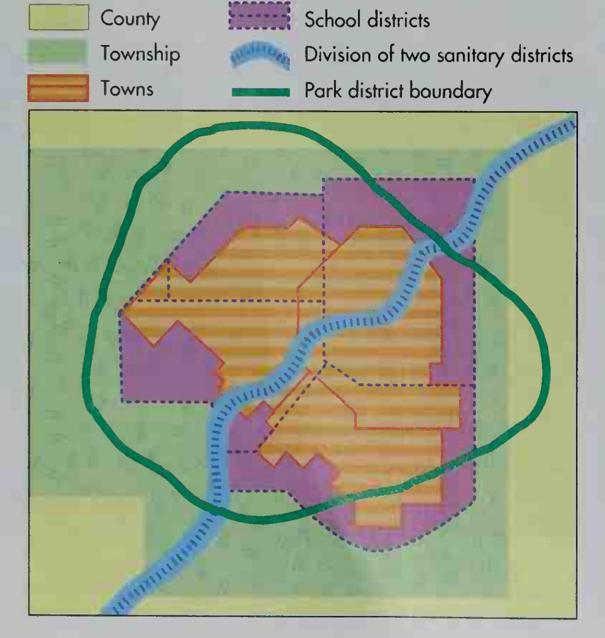
For more details on the functions and problems of local governments today, and of their relations with higher levels of government, see **Local government**. For a discussion of how city governments operate and are organized, see **City government**.

Solving city problems. Cities have made some effort to solve their problems, but much remains to be done. More money than is now available could partially solve some of the problems. In some countries, the funds would come from taxes paid by citizens and businesses. Some people favor extensive use of tax money for social improvement, but others oppose it. Government regula-

Metropolitan area governmental units

This diagram shows some of the governmental units that operate within a metropolitan area. Solutions to areawide problems are difficult, partly because no one unit has areawide authority.

WORLD BOOK diagram by Sarah Figlio



tion can also be used to help solve problems. For example, governments can demand that car manufacturers make cars that pollute the air less than today's vehicles do. Again, some people favor extensive government regulation as a solution, but others oppose it.

But money and government cannot solve all city problems. Some are too complex and too poorly understood to be solved rapidly. Also, government efforts to combat such problems as crime and pollution need help from citizens and businesses.

Cultural variety in cities

Metropolitan cities are filled with people from many different cultures, and this variety makes them interesting places to live. People who arrive from other countries often settle in cities. They bring many ideas about religion, food, language, and government to their new homes. For this reason, cultural contrasts are often more dramatic in cities than in smaller towns.

Many people choose to live in cities because they enjoy the variety of cultures found there. But cultural differences can add to urban conflict. Discrimination often occurs between cultural groups. In addition, older groups sometimes dislike newcomers because they do not welcome a challenge to their own culture.

Neighborhoods. Immigrants tend to settle near others with similar cultural backgrounds. Neighborhoods often develop with stores, restaurants, and houses of worship for people from certain cultures. In these neighborhoods, people may speak, read, and hear the language of their original country. They may buy books in Polish or rent videotapes from India. Many cities have an area called "Chinatown," where visitors can sample Chinese foods and buy imported products.

Immigration patterns often shape the neighborhoods and cultures found within a city. In the 1800's, for example, many neighborhoods in the United States attracted immigrants from Ireland or Eastern Europe. Today, many immigrants come from Latin America and Asia, especially Cambodia, Korea, and Vietnam. The Asians bring Buddhism and other non-Western religions to the United States. Latin Americans bring a tradition of large, close-knit families.

Political culture. One important way in which the cultural groups within a city may differ from one another is in their views on government. Social scientists use the term *political culture* to describe such views. For example, most people in some cultural groups believe strongly that citizens should actively participate in government. A majority from other groups feel that a low level of citizen participation is not a problem. Different cultural groups also tend to have different views on how a city's government should be organized, which services it should provide, and which problems it should try to solve first.

The existence of a variety of political cultures within a city can lead to friction. However, many people point out that a city can be strengthened by the existence of a wide range of viewpoints among its residents. For example, a city's immigrants may have lived under various types of governments and observed many different solutions to urban problems. As a result, they may bring to their adopted city new ideas and experiences that can help solve the city's problems.

Future cities

Sociologists have made various predictions about urban communities of the future. They believe that metropolitan areas will continue to grow in both population and area. In 1990, about 2 $\frac{1}{4}$ billion people in different parts of the world lived in urban places. By the year 2010, the number is expected to rise to about 4 billion people. In the United States in 1990, about 187 million people lived in urban places as defined by the U.S. government. By the year 2010, the number is expected to reach about 225 million.

Some new urban communities were built in the 1900's, and more will be built in the future. Like today's suburbs, the new communities will provide living space and ease the overcrowding problem caused by the population explosion and implosion. City planners hope that—unlike most suburbs—the new communities will also provide jobs for most of their residents. If the communities do so, the overcrowding of cities will be eased even more.

Communities that have such a self-supporting feature are called *new towns* or *new cities.* The United Kingdom and the Scandinavian countries have been leaders in the development of new towns. The governments of these nations provided much financial aid for this development. In the United States, where private enterprise plays the major role, only a few new towns have been developed. They include Columbia, Maryland, and Reston, Virginia.

Brazil built a new capital city, Brasília, in the mid-1900's. The Brazilian government located this city in the thinly populated interior of the country, hoping that the modern city will attract further development to the area.

The development of new towns and cities is a slow, costly process. Private developers are reluctant to take on such projects because of the uncertainty of—and the long wait for—profits. Many governments have been unable or unwilling to finance such projects. For these reasons, sociologists predict that almost all the additional millions of people who will live in urban places in the future will crowd into existing communities. More and more of the land around central cities will be filled by people. The suburbs will spread out so far that some metropolitan areas will run together with no rural areas between them. Such a continuous stretch of metropolitan areas is called a *megalopolis.* For example, a megalopolis has formed between Boston, New York City, Philadelphia, Baltimore, and Washington, D.C.

Sociologists also foresee physical changes in metropolitan areas. To absorb the increasing population, governments may permit tall buildings in areas where

they are now prohibited. Governments may also set aside much more land for parks and other recreational areas. They may try to solve traffic problems and improve safety by expanding public transportation and by creating separate roadways for automobiles, trucks, and pedestrians. See **City planning; Urban renewal.**

The effort to free cities of pollution seems sure to continue. Entire urban communities may be enclosed in plastic domes. Temperature and humidity inside the domes would be controlled, and electronic filters would keep the air clean and fresh. It is hoped that future cities and suburbs will offer the advantages of urban life without the disadvantages.

Henry C. Binford and Terry Nichols Clark

Study aids

Related articles. *World Book* has separate articles on hundreds of cities. Lists of U.S. cities appear at the end of the articles on the states, and Canadian cities appear at the end of the province articles. Cities of other countries are listed at the end of the articles on those countries. See also the following articles:

History

Athens
Babylon
City-state
Egypt, Ancient
Free city
Greece, Ancient
Guild
Industrial Revolution
Middle Ages
Phoenicia
Rome (The ancient city)
Rome, Ancient

City problems

Air pollution
Crime
Drug abuse
Environmental pollution (Local efforts)
Juvenile delinquency
Poverty
Riot
Segregation
Traffic (Traffic problems)
Waste disposal
Water pollution

Other related articles

Architecture
City government
City planning
Communication
Community
Education
Housing
Local government
Megalopolis
Metropolitan area
National League of Cities
Park (Kinds of parks)
Playground
Population
Public health
Road
School
Suburb
Technology
Transportation
Urban Coalition, National
Urban renewal

Outline

I. How cities began and developed
A. Advances in technology
B. Physical environment
C. Social organization
D. Population growth

II. Ancient cities
A. Description
B. The people
C. Economy
D. Government

III. Medieval cities
A. Description
B. The people
C. Economy
D. Government

IV. Industrial cities
A. Description
B. The people
C. Economy
D. Government

V. Metropolitan cities
A. Description
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VI. City problems
A. Physical problems
B. Social problems
C. Economic problems
D. Governmental problems
E. Solving city problems

VII. Cultural variety in cities
A. Neighborhoods
B. Political culture

VIII. Future cities

Questions

What are some of the reasons that so many people live in and near cities?
What are some of the problems of cities?
What city was founded by a steel company?
What is the *population explosion?* The *population implosion?* The *population displosion?*
How did medieval cities try to solve the problem of overcrowding?
How did the people of ancient cities attempt to please their gods?
What is a *megalopolis*?
What northern Italian coastal city remained a trading center throughout the Middle Ages?
How did the decline of manorialism contribute to the growth of cities?
Why can a city business section that covers a small area serve thousands of people daily?

Additional resources

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City government manages the affairs of and provides services for cities, towns, villages, and other communities. Communities with their own government are known as *municipalities,* and city government is also called *municipal government.*

About 75 percent of the people of the United States live in municipalities. The municipal governments provide a variety of services for residents. These services include police and fire protection, recreational facilities, street maintenance, and health and welfare services. Most of the states grant cities *home rule.* That is, the cities may, within the general laws of the state, adopt their own *charter* (form of organization) and have considerable freedom in local matters.

The United States has about 19,000 *incorporated* municipalities. An incorporated municipality is a corporation under the law and has a charter from the state defining its powers, responsibilities, and organization. Illinois leads the states with about 1,280. Hawaii, on the

other hand, has no incorporated cities. All of the cities and towns in Hawaii are governed as part of the county in which they are located. Nevada, New Hampshire, and Rhode Island have fewer than 20 incorporated municipalities each.

Municipalities vary greatly in size. The largest municipality in the United States is New York City, with about 7½ million people. The smallest municipalities may have only a few hundred residents.

All municipal governments perform similar functions and have similar organization. These governments are the principal providers of such services as police and fire protection, sanitation, water supply, and public health programs.

City governments are organized into three branches: (1) legislative, (2) executive, and (3) judicial. Legislative responsibilities are carried out by a lawmaking body called the *city council,* sometimes known as the *board of aldermen* or *city commission.* The council makes laws for the city in the form of *municipal ordinances.* The executive branch is headed by the mayor or city manager, who administers the city government and coordinates its public services. Courts, which make up the judicial branch, try people accused of violating municipal ordinances. They also deal with civil cases that involve settlements of limited amounts of money. In small municipalities that do not have their own courts, county or district courts handle most cases.

For information on city and other local governments, see the article on **Local government.** To learn about city government in Canada, see the section on *Local government* in each province article in *World Book.*

Forms of city government

There are two major forms of city government in the United States: the *mayor-council* form and the *council-manager* form. A small and steadily decreasing number of cities use a third type of government called the *commission* form.

The mayor-council form is the oldest type of city government in the United States. The first city governments in the American Colonies were patterned after those in England. They had a council, which was the chief organ of government, and a mayor, who was a member of the council and presided over it.

Under most mayor-council systems today, the mayor operates from a separate office and is not a member of the council. The people elect both the mayor and the council. More than one-third of the cities in the United States with populations of 25,000 or more have the mayor-council system.

There are two main types of mayor-council government: (1) the weak-mayor system and (2) the strong-mayor system. The weak-mayor system developed in the late 1700's and is the most popular type of government in small cities. The strong-mayor system developed in the late 1800's and is especially popular in large cities.

The weak-mayor system gives the mayor only limited executive authority. The council, on the other hand, has executive as well as legislative powers. In most cities, the mayor does not prepare the city budget and has little veto power over council decisions. In the weak-mayor system, the mayor appoints few, if any, of the city's top administrative officials, and these appointments may be subject to the approval of the council. Other top officials are chosen by the city council, the voters, or independent boards and commissions.

The chief criticism of the weak-mayor system is that responsibility is not centralized but divided among many officials. The mayor does not have a voice in selecting many department heads and consequently has difficulty coordinating the administration of city services. However, some people favor such decentralization of authority because they fear too much power vested in a single individual.

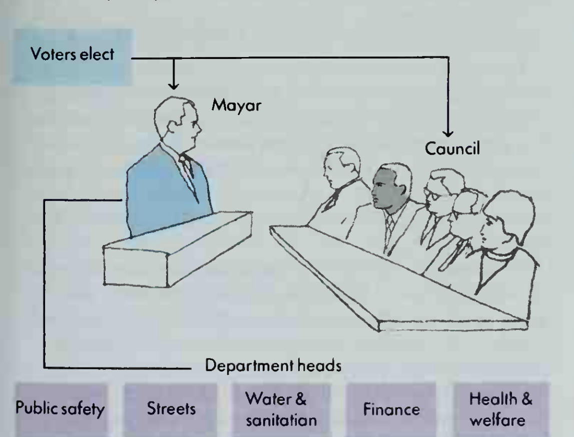
The strong-mayor system gives the mayor broad powers. The mayor can appoint and dismiss most department heads, veto acts of the council, prepare the

Mayor-council form of government

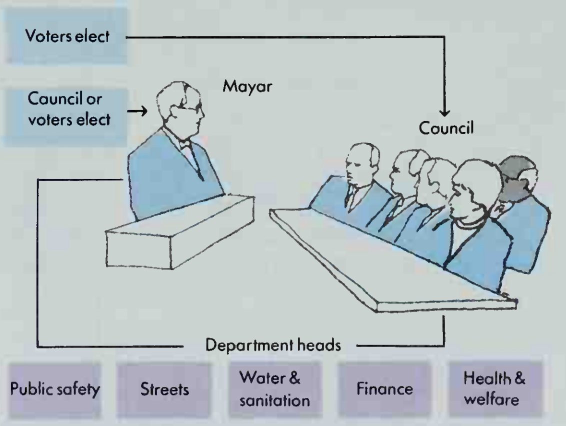
The council is the chief governing body of the city. Under the strong-mayor system, the mayor appoints most department heads and has direct control over them. Under the weak-mayor system, the mayor appoints few, if any, top administrative officials and has only limited control over them.

WORLD BOOK chart

Strong-Mayor System



Weak-Mayor System



budget, plan various programs, and direct the operation of all city departments. The mayor serves as the leader in city government and proposes legislation to the city council. However, the council determines basic government policy and raises revenue for the city.

Most experts on city government consider the strong-mayor system superior to the weak-mayor system. The centralization of authority in the office of the mayor assures better coordination of the services of city government. One of the chief weaknesses of the strong-mayor system is that conflicts often arise between the mayor and the council because they share policymaking powers. One reason most of the largest cities in the United States use the strong-mayor system is that satisfying the conflicting demands of a wide variety of social groups requires strong political leadership.

The council-manager form of government is also called the *city manager plan.* Under this form of government, a professional administrator called a *city manager* supervises all municipal affairs. An elected city council hires the city manager. Most councils have from five to nine members. The council-manager plan is the most common form of city government in the United States for cities with populations of 25,000 or more. More than half of all such cities use the council-manager system.

In most cities that use the council-manager form, the council members are elected on nonpartisan ballots. Usually, the mayor is a member of the council. He or she is either elected to the office by the people or selected by the other council members. The mayor presides at council meetings but seldom has more power than other members. The council is the chief governing body of the city. It determines policies and passes ordinances. The city manager carries out the policies set by the council. The council may dismiss the city manager if it is dissatisfied.

A chief feature of the council-manager plan is the centralization of administrative responsibility. The city manager appoints the heads of all departments and is responsible for managing all of the city services.

Council-manager form of government

The council determines city policies and appoints a city manager to carry them out. The city manager, in turn, appoints department heads and manages all city services.

WORLD BOOK chart

Council-manager government is modeled on the organization of a business firm. The city council corresponds to the board of directors of a corporation, and the city manager to a corporation's general manager. City managers, who have experience and special training in city administration, perform many of the governmental activities. Politics is supposed to play little or no part in their administrative decisions because they are appointed, not elected. However, some scholars believe that city managers lack the ability to handle political conflicts between ethnic groups, economic groups, or neighborhoods. They argue that council members selected in nonpartisan elections lack political experience and do not work well together. In addition, some cities have tended to blame all political weaknesses on the city manager and therefore have had high rates of turnover in managers.

The council-manager plan developed in the United States during the early 1900's. It was promoted by a businessman named Richard S. Childs and by the National Short Ballot Organization, a nonpartisan political group he founded. In 1908, Staunton, Va., hired a general manager to handle its administrative affairs under a mayor-council system. In 1912, Sumter, S.C., became the first city to adopt a complete council-manager government. The first large city to do so was Dayton, Ohio, in 1913.

The commission form of government combines legislative and executive authority in an elected group of commissioners. The number of commissioners varies from city to city, but most commissions are made up of five commissioners. Each commissioner heads a city department—such as public works, finance, or public safety—and is separately responsible for the administration of his or her department. The commission as a body has the power to pass ordinances, impose taxes, distribute funds for city needs, and appoint officials. One of the members may be designated as mayor for ceremonial functions and for presiding over commission meetings.

The chief objection to commission government has been that disagreements among commission members on issues involving more than one department make effective coordination difficult. Today, only about 25 U.S. cities with populations of 25,000 or more have a commission form of government.

Administering city government

City governments employ many people to provide services to residents. These employees are organized into many separate departments and agencies, such as the police department and the public library. Each department is headed by an administrator who is responsible to the mayor, city manager, or commissioners. These agencies and their employees are called the city *bureaucracy.*

Patronage is the practice of awarding jobs and government contracts based on people's service to the party in power. The patronage system was widely used in the 1800's. During the late 1800's, many reformers charged that the patronage system produced dishonest and inefficient city workers. The reformers urged that more city jobs should be filled by a civil service system based on merit. They also called for *nonpartisan elec-*

tions, in which candidates for city office are listed on the ballot with no indication of their political party. Today, about 75 percent of all municipalities in the United States hold nonpartisan elections for city offices.

Civil service includes all city government employees who are appointed rather than elected. The first state civil service system was established in New York in 1883. Today, all states and most large cities have civil service systems in which appointments are based on merit rather than on political connections. Applicants for such civil service jobs take an examination, and those with the highest scores are hired. Civil servants are protected against being fired from their jobs for political reasons.

By the 1970's, most states permitted some form of *collective bargaining* by civil service employees. In collective bargaining, the city government and its employees meet to arrange working conditions and salaries that are acceptable to both sides. Many city workers, including fire fighters and sanitation workers, are members of labor unions that bargain with city government. Unauthorized strikes by city workers sometimes occur. A few states permit strikes by some groups of city employees.

City finances

Sources of revenue. City governments have traditionally relied on property taxes to finance city services. The city collects these taxes from homeowners, businesses, and other owners of taxable property. The amount of tax is based on the estimated value of the property.

City governments rely in part on financial aid from state and federal governments. Much of this assistance comes in the form of *grants-in-aid.* Grants-in-aid are funds made available under certain conditions or for a certain program. Most grants from state governments may be used for general purposes, but the city must meet certain standards established by the state. Most federal aid consists of grants for such specific purposes as airport construction or improvements in city sewerage systems. The federal government also offers *block grants,* which cities may use for various projects within a certain area, such as housing or education. Many cities complain that the federal government issues *mandates* that require them to provide increased services but do not supply the necessary funding. For example, cities must meet federal standards for the removal of asbestos and lead-based paint from buildings. But the federal government provides little or no financial aid for such programs.

Expenditures. About 40 percent of a typical municipal budget goes to pay city workers. The rest is used for such lasting improvements as parks and museums, and for such specific purposes as buying library books and maintaining roads.

Budget problems. Many cities experienced serious budget difficulties in the late 1900's. For example, Cleveland *defaulted* (failed to pay) its debts in 1978 and could not pay them until 1980. Bridgeport, Connecticut, filed for bankruptcy in 1991 but withdrew the application in 1992. Many other cities were near default.

There were many reasons for city budget problems. In some older cities, the *tax base* (total value of property that can be taxed) decreased as people and businesses moved to the suburbs. Inflation also strained municipal budgets. Inflation, cuts in federal aid, and needs for services for such groups as homeless people and AIDS patients also strained municipal budgets. At times, many cities were forced to cut programs and to lay off city workers.

Influencing city government

People can influence their city government in many ways. They can act individually by voting in municipal elections and by writing or talking to city officials. They can join with others to organize and participate in political parties and other groups.

Municipal elections are held every four years in most cities. Elections enable citizens to vote for the officials and proposals of their choice. However, the number of people who vote in city elections is small in comparison with the number who vote in state or national elections. Only about one-third of the eligible voters cast their ballots in municipal elections.

Parties and other groups. During the late 1800's, political parties were extremely active in local government. They developed strong organizations called *machines,* which did favors for citizens in return for votes cast for party candidates. Party machines began to disappear during the early 1900's, when municipal governments adopted nonpartisan elections and other reform measures.

Groups called *special-interest groups* are probably the major influence on city government today. Business groups and downtown merchants call for policies to attract new industries. Minority groups may demand more jobs and better community services. Taxpayer organizations attempt to limit city spending and taxes. Neighborhood organizations support programs to reduce crime rates and to improve neighborhood conditions. Environmental groups may oppose the establishment of hazardous-waste sites and other projects that they believe threaten the environment or people's health. David C. Saffell

Related articles in *World Book* include:

Services of city government

City planning
Fire department
Health, Board of
Housing (Local housing controls)
Library (Public libraries)
Park
Police (City police)
Public health
Road
Sanitation
Sewage (Urban sewerage systems)
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Waste disposal
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Assessment
Borough
City
Home rule
Local government
Mayor
Metropolitan area
Patronage
Property tax
Revenue sharing
Suburb
Town
Town meeting
Traffic
Village

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Skidmore, Owings & Merrill (WORLD BOOK photo by Ralph Brunke)

City planning involves the work of many people, including city planners, architects, and economists. City planners work to improve existing communities and to develop new ones. The experts shown here are reviewing the design of a Japanese city.

City planning

City planning is the process of preparing programs to guide the development of cities and towns. City planners—the people who direct the process—advise local governments on ways to improve communities. They also advise governments and real estate developers who are planning entirely new neighborhoods and communities.

City planners deal chiefly with the physical layout of communities. They make proposals designed to beautify communities and to make life in them comfortable, enjoyable, and profitable. Their proposals include slum-clearance programs, projects to replace run-down housing, recreation areas, shopping centers, and plans to improve transportation and parking facilities.

Many city planners work for local governments. Others work for developers or groups of citizens who propose plans to the government. A city planner's day-to-day work chiefly involves improvements in parts of a community. But a planner views a community as a single system in which all the parts are dependent on one another. A planner may create a *master plan* (overall plan for the community) and use it as the basis for all the work. Such a plan shows the entire community both as it is and as the planner believes it should be. The city planner's suggestions for changes in any part of a community must follow the master plan. For example, the plan might restrict the height of buildings in residential areas. City planners must follow this restriction whenever they design changes for any residential area.

City planners try to predict the future. They attempt to forecast such developments as large changes in population and industrial activity. The predictions of city planners help a government plan for the future.

City planning began with the first cities—about 3500 B.C. Ancient peoples set aside areas for housing, worship, and other activities. They built walls around their communities for protection against enemies. Throughout history, people have done some planning for their communities. But the planning has not kept pace with the tremendous growth of urban communities. Many have become dirty, noisy, overcrowded, and run-down. City planners work to redevelop these communities and to manage new development in places that are rapidly growing. Since 1900, governments have greatly increased city planning activities in an attempt to help solve the many problems of cities and towns. For a discussion of these problems, see the *World Book* article on City (City problems).

The master plan

The preparation of master plans ranks among the most important duties of city planners. A master plan, also called a *comprehensive plan,* includes diagrams and models that show a community as it is and as the planner believes it should exist in the future. The plan includes reports and statistical information that support the planner's proposals.

A master plan shows how land should be used. It also shows how public facilities and services—such as schools, roads, fire and police stations, and water, sewerage, and transportation systems—should be improved or expanded. Planners call these services and facilities a community's *infrastructure.* In some cities, new developments are permitted only when a master plan allows the developments and when the infrastructure can provide certain levels of expanded service. In some states of the United States, a master plan is required before a city can proceed with development.

Preparing the plan. A professional city planner may consult many other professional experts in preparing a master plan. These experts might include architects, economists, educators, engineers, finance specialists, geographers, lawyers, political scientists, statisticians, and specialists in air and water quality. The city planner also seeks advice from nonprofessional people who will be affected by the plan. These people include business persons, homeowners, and members of citizens groups. The general public may also be allowed to participate in the preparation of the plan.

Today, many city planners use computers in their work. Computers process information that planners analyze in forming a plan. Planners also use computers to create maps and designs.

Many communities—mostly small ones—hire a private planning firm that prepares a master plan and submits it to the local government for approval. In many other communities, an agency of the local government does the planning job. In some communities—especially big cities—the government includes a department of city planning. This department prepares the master plan. The city planner and other department members are responsible to the top executive.

Proposals of the plan. A master plan aims to make community life more comfortable, enjoyable, safe, and profitable. A good plan provides transportation facilities that enable people to get to and from stores, offices, and factories quickly and easily. It also provides enough recreation areas, schools, and shopping facilities.

The major part of a master plan recommends how the community's land should be used. The plan divides the community into sections. It classifies some sections as residential areas, others as commercial and industrial areas, and the rest as public facility sites. It divides these major sections into smaller districts, each with certain building restrictions. For example, the plan reserves some parts of residential areas for houses only and some for both houses and small apartment buildings. It may propose construction of high-rise apartment buildings in other neighborhoods. The master plan may permit retail trade, wholesale trade, and light manufacturing in some commercial and industrial districts but forbid heavy manufacturing there. The plans may allow *mixed-use* development in some areas, with a combination of residential, commercial, and industrial sites.

A master plan may suggest ways to improve the appearance of a community. For example, it may propose treelined boulevards, parks, and a new civic center.

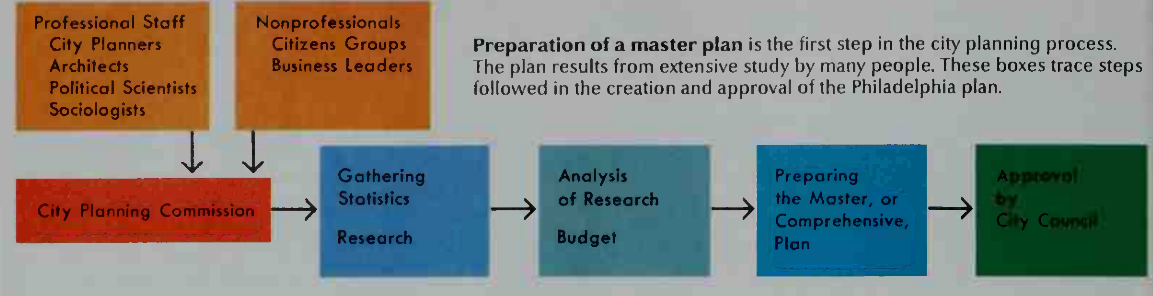
Skidmore, Owings & Merrill



A computer-generated drawing may be used by city planners to show proposed changes in the arrangement of buildings and other features of an urban area. This computer-generated drawing shows downtown Chicago.

Improving an existing community

City planning may involve rebuilding sections of a community according to a master plan. The illustrations below show how Philadelphia city planners worked to improve one section of the city. The model shows what they planned, and the photograph shows the finished project.



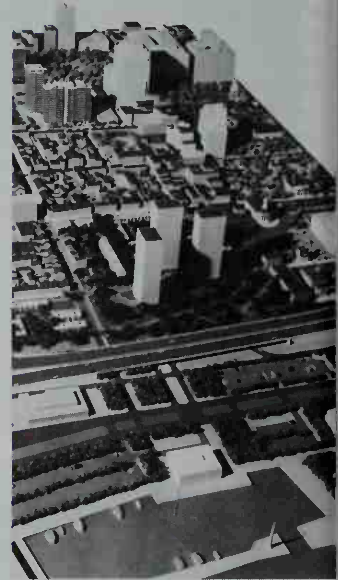
Preparation of a master plan is the first step in the city planning process. The plan results from extensive study by many people. These boxes trace steps followed in the creation and approval of the Philadelphia plan.

THE COMPREHENSIVE PLAN

THE PHYSICAL DEVELOPMENT PLAN FOR THE CITY OF PHILADELPHIA

Philadelphia City Planning Commission

A land-use map is a major part of a master plan. The land-use map at the left shows which sections of Philadelphia should be commercial, industrial, recreational, and residential areas.



Lawrence Williams, Philadelphia City Planning Commission

A planner's model shows how a section of the city would look according to the master plan. The model above calls for construction of three tall apartment buildings, *center,* and a nearby expressway above the ground.

© John McGrail

An aerial photograph shows how planners revised their design during construction of the project. The three apartment buildings, called Society Hill Towers, have been completed as planned, but the expressway runs below the ground.

Such improvements are sometimes called *urban design*.

The plan may include proposals for major changes in citywide facilities, such as sanitation and transportation systems. It may recommend a more complex sanitary drainage system for heavy manufacturing areas than for residential and commercial districts. The plan also may call for such developments as the widening of streets and the construction of a new expressway to ease travel between residential, commercial, and industrial areas.

City planners are still chiefly concerned with the physical layout of communities. But since the mid-1900's, many planners have also dealt with economic and social problems. Today, a city plan may include proposals for economic development, education, and health-care and welfare programs for the needy.

Making city planning work

City planners need both money and authority to carry out their programs. They get much of the money from local and federal governments. But governments get their money by taxing the people, so much of the money a city planner uses actually comes—indirectly—from the people. Local, state or provincial, and federal governments give city planners the authority they need to carry out their plans.

Gaining support for the plan. Strong public opposition can cause a government to refuse to act on proposals of a master plan. Proposals may lose support if the public believes they are too costly or would benefit only a small part of the population.

City planners are likely to gain public support with proposals that capture the imagination of the people. Such proposals include the development of housing, office buildings, and other facilities that can make a city more enjoyable. Sometimes a plan gains public support because it includes proposals for solving problems of deep concern to most of the people. For example, a proposal to improve roads may get wide support in a community that constantly has bad traffic jams.

Governmental authority. To carry out their plans, city planners must have influence over development and other activities that affect the layout of a community. They rely on the government's power of *eminent domain* and its authority to enforce zoning laws, subdivision regulations, and building and housing codes.

The term *eminent domain* describes a government's right to buy private property—even when the owner does not want to sell it. City planners must often rely on this power to get the land they need for major rebuilding projects. In the United States, governments have used it to carry out urban redevelopment programs and to build roads and other parts of a community's infrastructure. See **Eminent domain; Urban renewal.**

Zoning laws designate the kinds of buildings permitted in each part of a community. If a zoning law allows only houses and apartment buildings in a certain area, city planners know they can plan that area as completely residential. Zoning laws also allow planners to regulate sizes of lots, heights of buildings, the number and location of parking and loading areas, and the use of signs. See **Zoning.**

Other regulations control the subdivision and development of large, open land areas. Private real estate developers often buy large areas and subdivide them into lots. They either sell the empty lots or construct buildings on the lots before selling. Subdivision regulations designate the size of lots and other aspects of physical layout. For example, they cover the location and width of streets and the amount of land that must be used for public buildings, schools, and open space.

Building and housing codes regulate the safety and quality of construction. They also include rules that govern the number of occupants per building and the quality of electric wiring and plumbing.

Building new communities

The term *city planning* usually refers to attempts to improve existing communities. But it can also mean the development of entirely new communities. These communities, called *new cities* and *new towns,* differ from suburbs in at least one important way. Most suburbs are designed chiefly as residential communities for people who work in nearby cities. Planners of new communities try to make them fully or partly self-supporting by attracting businesses, thus providing places for the residents to work.

New cities and new towns differ from each other in location and in the degree to which they are self-supporting. Planners of new cities try to ensure that the communities have enough facilities and job opportunities for all the residents. Thus, new cities can be built far from existing cities. In the mid-1900's, the Brazilian government built Brazil's new capital, Brasília, far from the country's population center. New cities are extremely costly projects, and Brasília and Canberra, Australia, are among the few ever completed.

New towns provide jobs for many of their residents, but most rely on neighboring cities for many jobs. Most new towns are built within commuting distance of a big city. Others are communities within such a city.

The United Kingdom and the Scandinavian countries rank among the leaders in the development of new towns. The governments of these nations provide aid for new town development, including money and the authority to purchase the needed land. In the United States, private business is the major source of funds for new town development. But the development of a new town is a slow, costly process, and many private devel-



Rouse Company

Columbia, Md., one of the first *new towns* built in the United States, was begun during the early 1960's. New towns are completely new communities designed by city planners.

opers are reluctant to take on such a project.

Two of the first new towns built in the United States were Columbia, Maryland, and Reston, Virginia. Some private developers of several large-scale new towns received federal funds, technical assistance, and bond guarantees. These communities included Park Forest South (now University Park), near Chicago; St. Charles, near Waldorf, Maryland; and Soul City, near Henderson, North Carolina. In 1995, the Walt Disney Company opened Celebration, Florida, a privately financed new town with a school, a post office, and a health center.

Criticism of city planning

Although most people favor the goals of city planning, some criticize the methods used to achieve those goals. Major criticisms include the length of time needed to implement plans, the high cost of planning, government control of city planning, and what opponents feel is a wrong emphasis on certain goals.

Length of time required for city planning is the most common criticism. Some political leaders argue that the results of city planning often come too late to solve the problems that the planning was intended to address. Some private developers believe that planning causes delays that result in higher costs.

High cost is another common criticism of city planning. Critics claim that the cost of carrying out a master plan places too great a burden on the taxpayers. They argue that city planners try to do too much at one time.

Government control. Some people object to a government's power to force individuals to sell their property and to regulate its use. They view this power as a violation of owners' rights. Some people also object to the city planner's role as a decision maker because the planner is not an elected official.

Wrong emphasis. Some critics complain that city planners care more about beautifying communities and helping businesses than about solving such social problems as overcrowding and pollution. These critics also charge that changes made for a community's physical improvement sometimes increase the social problems. For example, a loss of low-cost housing results when luxury apartments replace run-down buildings.

Some people believe that city planners put too much emphasis on the future of cities and towns and not enough on present problems. Yet others criticize city planners who assist in trying to solve day-to-day problems. They believe that planners should concentrate on long-range programs because the planners are the officials most directly concerned with the future development of communities.

Reducing criticism. City planners need the public's support, and so they work to reduce criticism against their methods. More and more cities are scheduling planning projects farther and farther apart to reduce the financial burden on taxpayers and developers. Planners also hope that more and more people will become convinced of the value of city planning as they see the completed projects.

History of city planning

People have done some city planning ever since the first cities appeared about 3500 B.C. This section traces some of the highlights of city planning. For a detailed description of cities and their development through the ages, see **City**.

Ancient times. People of ancient cities set aside certain areas for meetings, recreation, trade, and worship. Many ancient peoples built walls around their cities to keep invaders out. Groups of public buildings and monuments are among the major examples of city planning in ancient times. Athens and Rome were especially famous for their public buildings and monuments. See **Athens; Rome** (The ancient city).

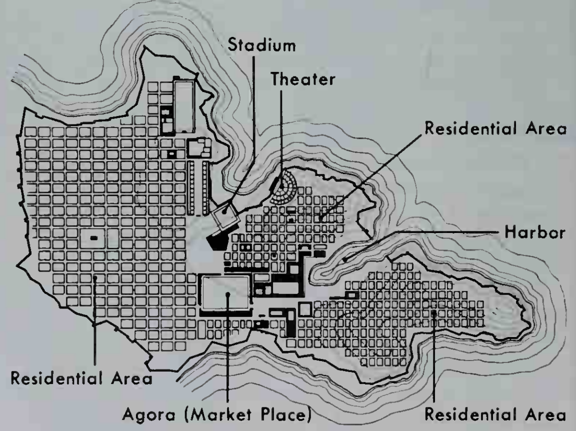
Historians believe that Hippodamus, an ancient Greek architect, developed the first systematic theories about city planning. His work included plans for the use of land and the location of streets and buildings in the cities of Miletus and Piraeus.

The Middle Ages. Many peoples built protective walls around their cities during the Middle Ages—from the A.D. 400's to the 1500's. Population growth caused a number of cities to become overcrowded. Some cities solved this problem by knocking down the walls. Other cities let the walls stand and built new cities nearby.

Religion played a major role in medieval European life and was reflected in the planning of many cities. The main church stood in the center of the city and was the biggest and most expensive building.

The Renaissance, a period of great artistic development, began near the end of the Middle Ages and lasted into the 1600's. Several leading artists of the Renaissance, including Gian Lorenzo Bernini, Leonardo da Vinci, and Michelangelo, helped beautify cities.

During the Renaissance and for many years after it, city planners designed parts of cities on a grand scale. They created open spaces to overcome the overcrowding of earlier days. Examples of this trend include the huge plazas in front of the Cathedral of Saint Mark in Venice and Saint Peter's Basilica in Vatican City. Another is the beautiful palace and gardens at Versailles, near Paris. Perhaps the high point of the trend toward city planning on a grand scale was Georges Eugene Haussmann's plan for Paris in the mid-1800's. Haussmann de-



Adapted from *The Urban Pattern* by Arthur B. Gallion and Simon Eisner, copyright 1950, 1963, by Litton Educational Publishing, Inc., by permission of Van Nostrand Reinhold Company

Miletus, an ancient Greek colony, was one of the first cities to have the regular arrangement of city blocks called the *gridiron pattern.* Hippodamus, the man who planned Miletus, is sometimes called the father of city planning.

signed wide boulevards and plazas and helped make Paris one of the world's most beautiful cities.

In colonial America, most cities and towns were smaller and less elaborate than the European communities. Early planned cities included Charleston, South Carolina; Philadelphia; Savannah, Georgia; and Washington, D.C. Washington was probably the most elaborately planned early American city. George Washington hired Pierre Charles L'Enfant, a French architect, to plan it.

The Industrial Revolution of the 1700's and early 1800's marked the beginning of the factory system of manufacturing. In Europe and North America, the population of many cities increased rapidly as thousands of workers left farms to take manufacturing jobs in cities. Cities became overcrowded, dirty, and noisy. Many people lived in crowded, run-down, unsanitary housing near the factories.

Social reformers began calling on governments to improve city life. They proposed new housing areas with gardens and open spaces and new communities with industry and housing in separate areas. Governments took some steps to regulate the quality of housing and to otherwise improve cities. But the cities continued to grow, and city planning failed to keep pace.

Planners tried to show what the ideal city could look like at the World's Columbian Exposition, held in Chicago in 1893. American architect Daniel Burnham planned and arranged most of the buildings at the exposition, which marked the beginning of the City Beautiful movement in the United States. Plans influenced by the movement were characterized by wide boulevards, spacious parks, and large, graceful public buildings.

Since 1900. Until the early 1900's, city planning in the United States was largely the responsibility of architects who were hired by private organizations or, in some cases, by governments. The rapid increase in urban problems during the late 1800's forced governments to take a greater part in city planning.

Between 1900 and 1930, many local governments in the United States established city planning commissions and introduced zoning laws. Among the most famous redevelopment plans of the early 1900's was Burnham's plan for Chicago, which reflected the style of the City Beautiful movement. The urban population explosion that followed World War II (1939-1945) caused severe housing shortages, more slums, and heavier traffic than ever. To meet the challenge of growing cities, planning agencies had to expand their programs to provide for new housing projects, parks and recreation areas, and better industrial and commercial districts.

Today, city planning is usually done by a partnership of government planning agencies and private developers. Such partnerships have redeveloped many run-down urban areas, including Faneuil Hall Marketplace in Boston, South Street Seaport in New York City, and Harborplace in Baltimore.

Careers in city planning

A professional city planner needs certain personal and educational qualifications. City planners have a special interest in design, social planning, and economic development. Most planning positions are available only to people who have a master's degree in city planning. Many colleges offer this degree.

People with a master's degree in city planning may have a bachelor's degree in any of a number of fields. These fields include architecture, computer programming, economics, engineering, finance, law, political science, statistics, and sociology. Anthony James Catanese

Related articles in *World Book* include:

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L'Enfant, Pierre C.
Road (Planning)
Sociology (Careers)
Soleri, Paolo
Tapiola
Urban renewal
Zoning

Outline

I. **The master plan**
  A. Preparing the plan
  B. Proposals of the plan
II. **Making city planning work**
  A. Gaining support for the plan
  B. Governmental authority
III. **Building new communities**
IV. **Criticism of city planning**
  A. Length of time
  B. High cost
  C. Government control
  D. Wrong emphasis
  E. Reducing criticism
V. **History of city planning**
VI. **Careers in city planning**

Questions

What does a master plan for a city include?
Who probably developed the first theories about city planning?
What is the power of *eminent domain*?
Why is public support important to a city planner?
What was the City Beautiful movement?
Why are there few new towns in the United States?
Who planned Washington, D.C.?
How do zoning laws help city planners?
What are some criticisms of city planning?
How did the Industrial Revolution increase the need for city planning?

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City-state is an independent or nearly independent state in which political and cultural activities are concentrated in a single urban center. City-states were often ruled by a king, by a dictator, or by a small group of powerful citizens. In some cases, political life was controlled by city dwellers, and in other cases by people of both the countryside and the city. The city-state had its fullest development in ancient times. The most famous examples were Athens and Sparta in Greece, and Rome before the formation of the Roman Empire in 27 B.C. During the Middle Ages, which lasted from about A.D. 500 to 1500, some German and Italian cities in the Holy Roman Empire became self-governing and almost entirely independent. They included Florence, Genoa, Milan, and Venice in Italy, and Bremen, Hamburg, and Lübeck in Germany. Ronald P. Legon

Related articles in *World Book* include:

Athens (Earliest times)
Ebla
Free city
Greece, Ancient
Hittites (History)
Italy (Rise of the city-states)
Phoenicia (Government)
Sparta

Ciudad Bolívar, *syoo DAHD boh LEE vahr* (pop. 225,846; met. area pop. 247,593), is a major port and commercial city on the Orinoco River in eastern Venezuela. For the location of Ciudad Bolívar, see **Venezuela** (political map). The port at Ciudad Bolívar has a large floating pontoon dock. Such goods as animal skins, cashews, latex, lumber, and palm fibers pass through the port. The city also ships gold and diamonds from the Guiana Highlands in southern Venezuela.

The Spanish founded what is now Ciudad Bolívar in 1764. They named it Angostura. In 1819, under the leadership of General Simón Bolívar, the Congress of Angostura organized the republic of Gran Colombia, which included what are now Venezuela and Colombia. Venezuela was liberated in 1821, and Angostura was renamed *Ciudad Bolívar,* which is Spanish for *Bolívar City.*

William J. Smole

Ciudad Trujillo. See **Santo Domingo.**

Civet, *SIHV iht,* is a furry mammal that looks somewhat like a long, slender cat. But a civet has a more pointed snout, a fluffier tail, and shorter legs than a cat. Civets live in Asia from India to Indonesia, and in Africa. The spotted skunk, found in most parts of the United States, is sometimes called a civet cat, though it is not a civet.

Civets vary in color and size. Their fur may be black, brown, gray, or tan. Most species, including the *banded palm civet* of Asia and the *African civet,* have dark spots or splotches, and the tail has rings of light and dark fur. A few species—such as the *masked palm civet* and the *small Indian civet,* both found in Asia—have a plain coat or only faint spots.

Civets range from about 13 inches (33 centimeters) to about 38 inches (97 centimeters) long. In addition, their muscular tail is sometimes as long as the rest of the body. Civets use their tail to grasp branches and to steady themselves while climbing trees.

Civets live within a specific area called a *territory.* Most kinds of civets climb well and spend much of their time in trees. Some civets sleep in tree holes or among tangled branches. A few species live mostly on the ground and dig burrows. Civets move about chiefly at night. They live alone, except for females and their young. Most civets eat birds, frogs, insects, rodents, and small reptiles. Excellent hearing, sight, and smell help civets hunt their prey. Civets also eat fruit and other parts of plants and the eggs of various animals. Palm civets feed chiefly on plants.

Some civets live near farmhouses and in villages. They help people by feeding on mice and rats, but they also may eat chickens and raid fruit orchards.

Civets mark their territory with a foul-smelling liquid from a gland near the base of the tail. Perfume manufacturers have used the liquid, called *civet musk,* from several species, especially the *African civet.* Civet musk makes the odor of perfume last longer.

Scientific classification. Civets belong to several genera in the family Viverridae. Bruce A. Brewer

See also **Mongoose.**

Civics is the study of the rights and responsibilities of citizens. Many middle schools and junior and senior high schools offer courses in civics, also called *citizenship education.* Civics students in the United States and many other countries learn about such subjects as democracy, freedom, and individual rights. They study the structure, function, and problems of government on the local, state, national, and international levels. The students also learn about other economic, political, and social institutions.

Civics teachers encourage students to participate in student government, school publications, and other school organizations. Students may also become involved in such community programs as voter registration drives and conservation projects. Francis P. Hunkins

See the **Government** article and its list of *Related articles.* See also **Social studies.**

Civil Air Patrol (CAP) is the volunteer civilian auxiliary of the United States Air Force. The CAP's three main missions are emergency services, aerospace education, and a cadet program. The CAP is not a government agency but operates with the advice and assistance of Civil Air Patrol-U.S. Air Force Headquarters at Maxwell Air Force Base, Ala.

The CAP has about 22,000 cadets from 13 to 18 years old and 35,000 senior members over 18. Members are organized into 52 wings—one for each state, plus Washington, D.C., and Puerto Rico—and about 1,750 local groups, squadrons, and flights. Members wear uniforms similar to those of the U.S. Air Force, but with distinctive CAP insignia and badges. The CAP has about 530 corporate-owned and 5,300 member-owned aircraft. It oper-

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A civet has a long, slender body, short legs, and a long, muscular tail. Civets live in Africa and in parts of Asia. The *African civet, left,* has grayish fur with dark spots or splotches.

ates a radio network of more than 16,000 fixed, mobile, and airborne stations.

Each year, CAP members fly about 85 percent of the hours flown on search and rescue missions directed by the Air Force Rescue Coordination Center at Langley Air Force Base, Virginia. CAP emergency services also include disaster relief.



Civil Air Patrol
Civil Air Patrol emblem

The CAP sponsors aerospace education courses in high schools. It also conducts workshops for training teachers in aviation-related subjects. The CAP awards scholarships and educational grants to selected members. It participates in an International Air Cadet Exchange program with more than 20 member countries and offers training in aerospace developments.

The Civil Air Patrol was established in 1941 as part of the Office of Civilian Defense. It organized and directed the activities of volunteer civilian pilots using their own aircraft and equipment for wartime tasks. The CAP was transferred to the War Department in 1943 as an auxiliary of the Army Air Forces. In 1946, Congress chartered it as a nonprofit private organization. The CAP became the civilian auxiliary of the U.S. Air Force in 1948. Its headquarters are at Maxwell Air Force Base in Alabama.

Critically reviewed by the Civil Air Patrol

Civil code. See Code Napoléon.

Civil defense is a government program that provides guidance and assistance in preparing for, responding to, and recovering from public emergencies. Public emergencies may result from blizzards, earthquakes, floods, hurricanes, tornadoes, explosions, and fires. Civil defense measures are designed to deal with immediate emergency conditions, protect the public, and restore vital services and facilities that have been destroyed or damaged by a disaster. Civil defense is also called *emergency management* or *disaster services.*

The first civil defense programs in the United States were developed in the first half of the 1900's. They were designed to protect the public from enemy attack in times of war. From the 1950's to the 1980's, civil defense focused primarily on measures for surviving nuclear attack. Today, the emphasis is on dealing with such hazards as natural disasters and terrorist attacks.

How civil defense is administered

In the United States, the federal, state, and local governments share responsibility for civil defense. The Federal Emergency Management Agency (FEMA), created in 1979, provides funding to state and local governments for civil defense personnel and for such emergency needs as warning systems, communications equipment, and *emergency operating centers.* Emergency operating centers are protected places where top officials can meet to direct activities in an emergency situation.

State and local civil defense organizations develop plans of action for emergencies. Every state has a civil defense director and assists the civil defense agencies of its cities and counties. Most cities and counties also have a civil defense director.

Civil defense in action

The first task of a civil defense agency in an emergency is to make sure the public is warned of danger and provided with instructions on how to avoid hazards. People may be able to protect themselves in one of two ways. They can (1) evacuate the area or (2) remain and take shelter. The civil defense agency works with local newspapers and radio and television stations to provide information to the public on what action to take. It also coordinates the efforts of other emergency workers, including rescue teams, firefighters, police officers, public works employees, and providers of medical care.

Warning includes notification of the community's emergency services organizations as well as the general public when dangerous situations arise. An emergency services official decides which warning system to use.

The following methods may be used to warn the public: (1) outdoor warning systems, including sirens, horns, whistles, and bells; (2) announcements over radio and television stations that are part of the Emergency Broadcast System; (3) mobile sirens of police and fire departments; (4) door-to-door visits by emergency personnel; and (5) telephone calls to schools and major employers.

Evacuation is the movement of people from a place of danger to a place of safety. Floods and hurricanes are the most common disasters that require evacuation. Unlike many disasters that strike suddenly, most floods and hurricanes can be predicted in time for people to leave the threatened area safely. People also may be asked to evacuate an area in the event of an accident involving hazardous materials, to protect them from toxic fumes, liquids, or smoke. People who are evacuated should go to the location designated by civil defense officials, using the route specified.

Shelter. Emergency shelters are usually in or near homes, schools, or places of work. These shelters provide temporary housing, food, clothing, and other essential needs for people who have been evacuated.

Emergency services. When a disaster strikes, the community's civil defense agency coordinates the response of emergency services—rescue operations, fire fighting, law enforcement, public works repair, and medical care. Government employees, often with the help of private organizations and volunteers, evacuate people and provide care for the injured and food and shelter for people who have had to leave their homes.

Recovery. Communities begin recovery activities as soon as possible after an emergency. Workers clear away debris, and utility companies restore telephone, water, gas, and electrical services. Welfare organizations help disaster victims who have been left homeless. Some communities provide counseling for both victims and emergency personnel who suffer psychological damage as a result of a disaster.

In the event of an especially destructive flood, hurricane, winter storm, or other disaster, the president of the United States



Civil defense symbol

may declare one or more cities or counties to be a *disaster area*. Such a declaration makes the area eligible to receive funds and other assistance from the federal government to help deal with the disaster. FEMA coordinates these federal relief efforts.

History

Beginnings. From 1916 to 1918, during World War I, a federal agency called the Council of National Defense directed the U.S. civil defense program. From 1941 to 1945, during World War II, the Office of Civilian Defense coordinated the nation's civil defense activities. The Federal Civil Defense Act of 1950 established the foundation of the country's present civil defense system.

The Cold War. From 1950 to the 1980's, the focus of the civil defense program was preparedness for nuclear attack. In 1945, during World War II, the United States had become the first country to use nuclear weapons. American planes dropped atomic bombs on the Japanese cities of Hiroshima and Nagasaki. In 1949, the Soviet Union tested its first atomic bomb.

By the late 1940's, tension between the Soviet Union and the United States led to a bitter struggle known as the Cold War. The Cold War was characterized by mutual distrust and suspicion between the two countries. At times, these conditions seemed to increase the likelihood of a nuclear war.

The fallout shelter program. In 1961, the U.S. Office of Civilian Defense Mobilization began a public fallout shelter program. Its purpose was to identify—and stock with supplies—buildings and underground areas where people would be protected from the fallout particles of a nuclear explosion. Fallout gives off radiation that can cause illness and death. Buildings made of such heavy materials as brick, concrete, or stone can block most of the radiation.

The federal government began to designate buildings and underground areas as fallout shelters. Many public shelters were set up in the basements of apartment and office buildings, factories, schools, and other large structures, or in windowless central areas in buildings



Reuters/Bettmann

In an emergency shelter, a Florida family receives a hot meal after a hurricane has struck. A community's civil defense agency coordinates such emergency services when a disaster occurs.

What to do in a disaster

This check list outlines some basic measures to take when a disaster strikes.

1. **Remain calm and patient.**
2. **Check for injuries and give first aid.** Get help for anyone who is seriously injured.
3. **Listen to a battery-powered radio for news and instructions, and evacuate if advised to do so.** If you must evacuate, take some supplies with you—enough to last 72 hours, if possible. Take food (including baby food and formula, if appropriate), water, medicines, sleeping bag or other bedding, clothing, battery-powered radio and lights, and spare batteries. Wear appropriate clothing and sturdy shoes.
4. **Check for damage in your home:**
   - Use a flashlight. Do not light matches or turn on electrical switches if you suspect damage.
   - Check for fires, fire hazards, and other home hazards.
   - Sniff for gas leaks, starting at the water heater. If you smell gas or suspect a leak, turn off the main gas valve, open windows, and get everyone outside quickly.
   - Shut off any other damaged utilities.
   - Clean up spilled medicines, bleaches, gasoline, and other flammable liquids immediately.
5. **Remember to:**
   - Confine and secure your pets.
   - Check on your neighbors, especially anyone who is elderly or disabled.
   - Make sure you have an adequate water supply in case service is cut off.
   - Stay away from downed power lines.

aboveground. In 1979, the newly created Federal Emergency Management Agency began managing the federal government's fallout shelter program.

Recent developments. In the late 1980's, relations between the United States and the Soviet Union began to improve dramatically. As the threat of nuclear war diminished, FEMA reduced the emphasis on preparedness for nuclear attack. Instead, the agency concentrated on coping with natural disasters and other similar hazards. In 1991, the Soviet Union broke up into a number of independent states. The following year, FEMA discontinued funding the fallout shelter identification program.

On Sept. 11, 2001, the United States experienced the worst terrorist attack in its history. Terrorists crashed hijacked jetliners into the World Trade Center in New York City and the Pentagon Building near Washington, D.C. About 3,000 people were killed. Following the attack, the focus of civil defense shifted toward preparation for terrorist threats, including biological and chemical attacks. President George W. Bush established a new government office, the Office of Homeland Security, to help protect the country against such threats. In 2002, Bush proposed expanding the office into the Department of Homeland Security and bringing FEMA and a number of federal agencies under its control.

Civil defense in other countries

In Canada, a federal agency called Emergency Preparedness Canada administers civil defense. It coordinates emergency planning by all federal agencies and departments. In addition, it helps the nation's cities, provinces, and territories plan for major emergencies. Emergency Preparedness Canada is part of Canada's Department of National Defence. Civil defense programs are also conducted by the governments of many other

countries, including Denmark, Norway, Russia, Sweden, Switzerland, and the United Kingdom.

Critically reviewed by the Federal Emergency Management Agency

See also **Federal Emergency Management Agency.**

Civil disobedience is the deliberate and public refusal to obey a law. Some people use civil disobedience as a form of protest to attract attention to what they consider unjust or unconstitutional laws or policies. They hope their actions will move other people to correct the injustices. Other people regard civil disobedience as a matter of individual religious or moral conviction. They refuse to obey laws that they believe violate their personal principles.

People who practice civil disobedience accept willingly their punishment for breaking the law. In this way, they can dramatically demonstrate their deep concern about the situation they are protesting.

Many lawbreakers use violence. But most acts of civil disobedience are nonviolent. Civil disobedience is usually distinguished from riot, rebellion, and other types of violent opposition to law and authority.

Is civil disobedience ever justified? Throughout history, there has been widespread disagreement concerning the use of civil disobedience in a society based on law and order. Some people claim that citizens are obligated to disobey laws they consider unjust, such as laws segregating the races. They say that such lawbreaking may be the best way to test the constitutionality of a law. Some defend the use of civil disobedience by pointing to Nazi Germany's laws calling for extermination of Jews and other groups.

Other people claim that it is never right to break a law deliberately. They argue that defiance of any law leads to contempt for other laws. Any act of civil disobedience, they believe, weakens society and may lead to violence and *anarchy* (no government or law).

Many people approve civil disobedience only in extreme circumstances, and then only if it is nonviolent. They argue that injustices can usually be corrected legally through democratic processes. Free elections give people a chance to choose their leaders and express their views. Various constitutional provisions also protect the right of dissent and protest.

History of civil disobedience. People have practiced civil disobedience for hundreds of years. When the disciples of Jesus Christ were ordered by the state to stop their teachings, they replied that they would obey God rather than mortals. In the A.D. 1200's, the Christian theologian Saint Thomas Aquinas argued that people must disobey earthly rulers when the laws of the state disagree with the laws of nature, or God.

During the 1600's and 1700's, certain religious sects became known for civil disobedience. For example, the Quakers in colonial America refused to pay taxes for military purposes because they disapproved of war. In the 1850's, abolitionists in the United States disobeyed the Fugitive Slave Law, which sought to compel the return of runaway slaves.

Many leaders of the women's rights movement used civil disobedience to call attention to their demands. In 1872, for example, Susan B. Anthony was arrested for voting before it was legal for American women to vote. Her trial attracted nationwide attention.

The American writer Henry David Thoreau was one of the most influential spokesmen for civil disobedience. In 1846, he spent a night in jail for refusing to pay taxes. He argued that he did not owe allegiance to a government that captured runaway slaves and waged war on Mexico to expand its area of slavery. In his essay "On the Duty of Civil Disobedience" (1849), Thoreau declared that people should refuse to obey any law they believe is unjust. He wrote: "Must the citizen ever for a moment, or in the least degree, resign his conscience to the legislator? Why has every man a conscience then?...It is not desirable to cultivate a respect for the law, so much as for the right. The only obligation which I have a right to assume is to do at any time what I think right....If the injustice is part of the necessary friction of the machine of government, let it go, let it go. ...but if it is of such a nature that it requires you to be the agent of injustice to another, then I say, break the law."

Thoreau's essay strongly influenced Mohandas K. Gandhi of India. Led by Gandhi, the Indian people used such nonviolent acts as strikes and protest marches to free themselves of British rule. They gained independence in 1947.

In the United States, during the 1950's and 1960's, Martin Luther King, Jr., and other civil rights workers deliberately violated Southern segregation laws as a way of fighting racial injustice. Many opponents of the Vietnam War (1957-1975) committed various illegal acts in attempts to change U.S. policy. Some refused to pay their taxes. Others refused to register for the draft. During the 1980's, nonviolent protests were directed at the repressive racial policy of *apartheid* (segregation) of the minority white government in South Africa. Leon F. Litwack

See also **Gandhi, Mohandas K.; India** (Rise of Indian nationalism); **King, Martin Luther, Jr.** (The early civil rights movement); **Thoreau, Henry David** (His beliefs and works).

Civil engineering. See **Engineering** (The branches of engineering).

Civil law is a term with several meanings. The term is often used to describe the rules of private law and to set them apart from the rules of criminal law. When used in this way, civil law covers such matters as contracts, ownership of property, and payment for personal injury. These matters usually involve private citizens. But the state may become party to a civil suit when it enters into a contract or causes personal injury. Criminal law deals with actions that are harmful to society and that society has made a crime.

The term *civil law* can also mean the law of most European countries, as opposed to the *common law* of the United Kingdom and every state of the United States except Louisiana. Under this type of civil law, *codes* (sets of rules) approved by legislatures are the primary sources used by judges to decide cases. Under common law, judges base their decisions chiefly on court decisions in similar cases. See **Common law; Louisiana** (Courts).

Originally, civil law referred to the code of laws collected by the Roman emperor Justinian in the A.D. 500's. These laws were used to govern the Roman Empire. A new civil law became popular in most of Europe after it took effect in France in 1804. This law, called the *Code Napoléon* or *Code Civil,* combined the Roman law and the law of northern France. It is the basis of present law in Quebec, Mexico, and some South American nations.

In the United States, many areas of law have been arranged into codes. Examples include the law of business and the law of crimes. Sherman L. Cohn

Related articles in *World Book* include:

Code	Justinian Code
Code Napoléon	Law (Private law; The development of law)
Contract	
Court	Negligence
Damages	Suit
Equity	Tort
Fraud	Trespass

Civil liberties. See Civil rights.

Civil Liberties Union, American. See American Civil Liberties Union.

Civil rights are the freedoms and rights that a person may have as a member of a community, state, or nation. Civil rights include freedom of speech, of the press, and of religion. Among others are the right to own property and to receive fair and equal treatment from government, other persons, and private groups.

In democratic countries, a person's civil rights are protected by law and custom. The constitutions of many democracies have *bills of rights* that describe basic liberties and rights. Courts of law decide whether a person's civil rights have been violated. The courts also determine the limits of civil rights, so that people do not use their freedoms to violate the rights of others.

In many nondemocratic countries, the government claims to respect and guarantee civil rights. But in most of these countries, such claims differ greatly from the actual conditions. In some Communist countries, for example, the people are denied such basic rights as freedom of speech and of the press. Yet their constitutions guarantee these rights.

Some people draw sharp distinctions between *civil liberties* and *civil rights.* These people distinguish between *freedom from* certain actions and *freedom to* be treated in certain ways. They regard civil liberties as guarantees that a person will enjoy *freedom from* government interference. They think of civil rights as guarantees that all people will have the *freedom to* be treated equally. For example, civil liberties would include freedom from government interference with a person's right to free speech. Civil rights would include everyone's freedom to receive equal protection of the law. In this article, the term *civil rights* refers to both civil liberties and civil rights.

Limits of civil rights

All civil rights have limits, even in democratic countries. For example, a person may be denied freedom of speech in a democracy if it can be shown that his or her speech might lead to the overthrow of the government. A person may not use civil rights to justify actions that might seriously harm the health, welfare, safety, or morals of others. In 1919, U.S. Supreme Court Justice Oliver Wendell Holmes, Jr., wrote: "The most stringent protection of free speech would not protect a man in falsely shouting fire in a theatre and causing a panic."

A person may be denied a civil right if that right is used to violate other people's rights. Freedom of expression, for example, does not permit a person to tell lies that ruin another person's reputation. Property owners have the right to do what they choose with their property. However, this right may not allow a person legally to refuse to sell property to a person of a certain race or religion. This is because the property owner would be denying the other person equal freedom of choice.

The specific limits of civil rights vary with the times. In time of war, a government may restrict personal freedoms to safeguard the country. Changing social and economic conditions also cause changes in the importance that people give certain rights. During the late 1800's, most people in the United States valued property rights more than personal freedoms. But since the late 1930's, most Americans have shown greater concern for personal freedoms and equality of opportunity.

Civil rights in the United States

The United States Constitution describes the basic civil rights of American citizens. The first 10 amendments to the Constitution are usually regarded as the U.S. Bill of Rights. However, civil rights are also mentioned in the main body of the Constitution and in later amendments. Each state constitution also has a bill or declaration of rights. Since the mid-1950's, the federal, state, and local governments have passed several civil rights laws. But the courts—especially the Supreme Court—have probably done the most to define civil rights. When Americans raise questions about the extent and limits of civil rights, they turn to the Supreme Court's decisions for the answers. The court often defines the limits of a right by balancing the right of the individual against the rights of society in general.

For a detailed description of the constitutional rights of Americans, see **Constitution of the United States.** For information on the Supreme Court's part in protecting civil rights, see **Supreme Court of the United States** (Civil rights).

The First Amendment is the basis of the democratic process in the United States. The First Amendment forbids Congress to pass laws restricting freedom of speech, of the press, of peaceful assembly, or of petition. Many people consider freedom of speech the most important freedom and the foundation of all other freedoms. The First Amendment also forbids Congress to pass laws establishing a state religion or restricting religious freedom. The Supreme Court has ruled that the 14th Amendment makes the guarantees of the 1st Amendment apply to the state governments.

Due process. Many parts of the Constitution, congressional and state laws, and court decisions require the government to treat individuals fairly. These requirements reflect a basic principle in the American legal system called *due process.* The 5th and 14th amendments forbid the government to deprive a person of life, liberty, or property "without due process of law."

Various statements in the Constitution guarantee due process. For example, the Constitution forbids the government to suspend the *writ of habeas corpus* except during an invasion or rebellion. This right protects citizens against arrest and detention without good reason. Neither Congress nor the states may pass *bills of attainder.* Such bills declare a person guilty of a crime and take away the person's property and civil rights without a trial. The Constitution also prohibits *ex post facto laws.* Such laws make a particular act a crime and punish people who committed the act before it was a crime.

Due process of law also includes court procedures

that protect individuals accused of wrongdoing. For example, a person may not be tried for a major federal crime unless a grand jury has first decided that enough evidence exists against the individual. Persons accused of a crime also must be informed of their constitutional rights and of the charges against them. They may demand a jury trial, which must be held soon after the charges are filed. Persons on trial may cross-examine their accusers and may force witnesses to testify.

Other constitutional guarantees. The Constitution also guarantees that accused persons may not be tried twice for the same crime, and they may not be forced to testify against themselves. If they cannot afford a lawyer and want one, the government must provide one. Persons accused of crimes must not be required to pay excessive bail. In addition, those convicted of crimes must not be fined excessively nor made to suffer cruel or unusual punishment.

The Constitution also provides for the security of people and their property. The government may not conduct "unreasonable searches and seizures" of persons or property. It may not take a person's property without due process of law. If it takes private property for public use, it must pay the owner a fair price.

The Constitution forbids the states to pass laws interfering with contracts made between persons or groups. Each state must recognize the legislative acts, public records, and court decisions of other states. A state must extend its legal protections to the citizens of any other state while they are within its jurisdiction.

Protecting the rights of minorities. The United States has many minority groups. These minorities include blacks, Jews, Asian Americans, European immigrants, Hispanic Americans, American Indians, homosexuals, and people with handicaps. Members of these groups often have not had an equal chance for economic, political, or social advancement. Members of some minorities have been denied the right to vote. Many persons have been discriminated against in housing, education, and employment, and have been denied equal access to restaurants, hotels, and other public accommodations and facilities. A main goal has been to end such discrimination and guarantee equal rights and opportunities for all people.

The struggle for the rights of blacks. Black Americans, who make up the largest minority group in the United States, have been denied their full civil rights more than any other minority group.

Black Americans made significant gains in their struggle for equal rights during *Reconstruction,* the 12-year period after the American Civil War. The 13th Amendment, adopted in 1865, abolished slavery in the United States. In 1868, the 14th Amendment made the former slaves citizens. It also provided that the states must grant all people within their jurisdiction "equal protection of the laws." The 15th Amendment, which became law in 1870, prohibited the states from denying people the right to vote because of their race. During Reconstruction, Congress passed several laws to protect blacks' civil rights. See **Reconstruction**.

During the late 1870's, white Americans increasingly disregarded the newly won rights of black Americans. The government itself contributed greatly to denying blacks their rights. In 1883, the Supreme Court ruled that congressional acts to prevent racial discrimination by private individuals were unconstitutional. In 1896, in the case of *Plessy v. Ferguson,* the Supreme Court upheld a Louisiana law requiring separate but equal accommodations for blacks and whites in railroad cars. For over 50 years, many Southern states used the "separate but equal" rule established in this case to segregate the races in public schools, and in transportation, recreation, and such public establishments as hotels and restaurants. Many states also used literacy tests, poll taxes, and other means to deprive blacks of their voting rights. See **Voting** (Restrictions on voting).

Since the 1930's, blacks have had fairer hearings on civil rights cases in the federal courts. The high point came in 1954 in *Brown v. Board of Education of Topeka.* In this case, the Supreme Court ruled that segregation in public schools is unconstitutional. In time, this decision broke down the "separate but equal" principle.

In 1955, the Supreme Court ordered that public school desegregation be carried out "with all deliberate speed." But many Southern school districts continued to have segregated schools. In 1969, the court departed from its "all deliberate speed" doctrine and ordered the integration of all school systems "at once." By the 1980's, public schools in the South were more integrated than those in many Northern and Western states.

In 1957, Congress passed the first federal civil rights law since Reconstruction. The Civil Rights Act of 1957 set up the Commission on Civil Rights to investigate charges of denial of civil rights. It also created the Civil Rights Division in the Department of Justice to enforce federal civil rights laws and regulations.

During the 1960's, black Americans' voting rights received increased protection. The Civil Rights Act of 1960 provided for the appointment of referees to help blacks register to vote. The 24th Amendment, adopted in 1964, barred poll taxes in federal elections. The Voting Rights Act of 1965 outlawed literacy tests in many Southern states. A 1970 law made literacy tests illegal in all the states. In 1966, the Supreme Court prohibited poll taxes in state and local elections.

The Civil Rights Act of 1964 was one of the strongest civil rights bills in U.S. history. It ordered restaurants, hotels, and other businesses that serve the general public to serve all people without regard to race, color, religion, or national origin. It also barred discrimination by employers and unions, and established the Equal Employment Opportunity Commission to enforce fair employment practices. In addition, the act provided for a cutoff of federal funds from any program or activity that allowed racial discrimination.

The Civil Rights Act of 1968 aimed chiefly at ending discrimination in the sale or rental of housing. Also in 1968, the Supreme Court ruled that the federal government had the power to enforce housing-discrimination laws even in cases involving only private individuals. Before the court's ruling, such laws had been applied only to cases that involved government agencies.

The struggle for women's rights in the United States at first concentrated on gaining the right to vote. A proposed constitutional amendment granting women the vote was introduced in every session of Congress from 1878 to 1919. In 1920, it finally became law as the 19th Amendment to the Constitution.

During the mid-1900's, women gained increased protection against job discrimination. In the 1940's, the U.S. government established a policy of equal pay for equal work. Under this policy, the government forbade businesses with federal contracts to pay a woman less than a man for the same job. Title VII of the Civil Rights Act of 1964 prohibited job discrimination on the basis of sex. In 1972, Congress approved the Equal Rights Amendment. It failed to become law because only 35 of the necessary 38 states approved it by the deadline of June 30, 1982. The amendment would have guaranteed equal rights for all citizens, regardless of sex.

Major changes in the field of civil rights occurred during the 1970's. Earlier civil rights efforts had involved lawsuits and other attempts to protect individual rights. In the 1970's, the emphasis shifted from individual rights to group rights.

The federal government began to enact laws designed to assure rights for groups that formerly had suffered discrimination. For example, the government began a program of *affirmative action.* Affirmative action consists of efforts to counteract past discrimination by giving special help to disadvantaged groups. Typical measures included recruiting drives among women and minority groups, and special training for minority workers. The government required such plans to be set up by businesses that had government contracts, by other employers, and by schools receiving federal funds.

Efforts to help groups that had suffered discrimination raised a number of new civil rights issues. Many people felt the government violated the principle of equality under the law by giving preference to certain groups at the expense of others. Some white men complained of *reverse discrimination,* saying they were treated unfairly because of their race and sex. Other individuals believed such efforts were necessary to help the disadvantaged overcome past discrimination and eventually compete on an equal basis with white males.

In 1995, the Supreme Court ruled that a federal program requiring preference based on a person's race is unconstitutional unless the preference is designed to make up for specific instances of past discrimination. This meant that affirmative action could no longer be used to counteract racial discrimination by society as a whole. In 1989, the court had made a similar decision regarding state and local programs.

In 1990, Congress passed the Americans with Disabilities Act to protect handicapped people from discrimination by private employers. The law also requires that public buildings and mass transportation systems be accessible to disabled people. In addition, the act orders telephone companies to provide telephone relay services that enable people with speech or hearing disorders to make and receive calls.

In 1996, the Supreme Court struck down an amendment to the Colorado Constitution that forbade laws protecting homosexuals from discrimination. Several Colorado cities had adopted such laws. The constitutional amendment was approved by a majority of Colorado's voters in 1992. In 1986, the Supreme Court had ruled that states could outlaw homosexual conduct.

Civil rights in Canada

The Canadian and U.S. governments apply the same broad principles in dealing with civil rights. Generally, Canadian courts have protected individual liberties, and most of the provinces have civil rights laws similar to those in the United States. In 1960, Canada's Parliament passed an act establishing the Canadian Bill of Rights. An expanded version of the bill, called the Canadian Charter of Rights and Freedoms, became part of Canada's Constitution in 1982. The charter is similar to the U.S. Bill of Rights. It guarantees the same basic freedoms and most of the same protections.

As in the United States, the main civil rights problems in Canada involve assuring equal rights for members of minority groups. In the past, Canadian Inuit (formerly called Eskimos) and Indians were sometimes denied their full civil rights. French Canadians of the province of Quebec have long struggled against what they consider discrimination by Canada's English-speaking majority. Many French Canadians claim they have been denied jobs because they speak French rather than English.

Development of civil rights

Natural law. The idea that people have certain rights that cannot be taken away probably began thousands of years ago with the theory of natural law. This theory states that a natural order exists in the universe because all things are created by nature, or God. Everything has its own qualities and is subject to the rules of nature to achieve its full potential. According to this theory, anything that detracts from a person's human qualities, or prevents their full achievement, violates natural law.

The ancient Greek philosophers and the writers of the Old Testament stressed that there is a higher law than human law. In the first century B.C., the Roman philosopher Cicero insisted that this higher (natural) law is universal and can be discovered through human reason. This idea led to the belief that governmental power has limits, and that people and governments everywhere are bound by natural law.

Some of the most historic English legal documents are based on natural law. The earliest and most famous was Magna Carta, which the king approved against his will in 1215. The document placed the king himself under the law. In 1628, the English Parliament drew up a Petition of Right. The petition claimed that certain actions of the king, such as levying taxes without the consent of Parliament, were unconstitutional.

Natural rights. Natural law had always stressed the duties over the rights of government and individuals. But in the late 1600's, natural law began to emphasize natural rights. This change was brought about largely by the writings of the English philosopher John Locke.

Locke argued that governmental authority depends on the people's consent. According to Locke, people originally lived in a state of nature with no restrictions on their freedom. Then they came to realize that confusion would result if each person enforced his or her own rights. People agreed to live under a common government, but not to surrender their "rights of nature" to the government. Instead, they expected the government to protect these rights, especially the rights of life, liberty, and property. Locke's ideas of limited government and natural rights became part of the English Bill of Rights (1689), the French Declaration of the Rights of Man (1789), and the U.S. Bill of Rights (1791).

Today, many scholars reject the natural law and natural rights theories. They believe that all laws—including those guaranteeing civil rights—are simply devices that people find convenient or useful at a particular time. Nevertheless, nearly all civil rights laws have resulted from the theories of natural law and natural rights.

Civil rights today. Civil rights have long been protected in the constitutional democracies of Western Europe. These nations include France, the United Kingdom, Switzerland, and the Scandinavian countries. Personal liberties are also secure in such newer democracies as Australia, New Zealand, Canada, and the United States. Many new nations of Africa and Asia have adopted constitutions that guarantee basic civil rights. But in many of these countries, unstable governments and inexperience with self-rule have often led to political arrests, censorship, and other denials of civil rights.

Most nondemocratic governments claim to protect civil rights. But in practice, they grant civil rights only when they find it politically convenient to do so. China's Constitution, for example, guarantees the right to vote and assures freedom of speech, of the press, and of assembly. But China's Communist Party completely controls the government, and the people may be punished if they publicly criticize the party. The Chinese government controls the newspapers and other forms of communication.

The United Nations General Assembly adopted a Universal Declaration of Human Rights in 1948. It states that all people are born free and are equal in dignity and rights. Many experts in international law believe that the declaration lacks legal authority, but most agree that it has high moral authority. Bruce Allen Murphy

Related articles. See the list of *Related articles* in the **African Americans** article. See also:

Affirmative action
African Americans (The civil rights movement)
American Civil Liberties Union
Amnesty International
Attainder
Bakke case
Bill of Rights
Brown v. Board of Education of Topeka
Censorship
Citizenship
Civil Rights, Commission on
Civil Rights Act of 1964
Class action
Constitution of the United States
Declaration of Independence
Democracy
Due process of law
Equal Employment Opportunity Commission
Equal Rights Amendment
Feminism
Fifth Amendment
Fourteenth Amendment
Freedom
Freedom of assembly
Freedom of religion
Freedom of speech
Freedom of the press
Gay rights movement
Great Society
Habeas corpus
Human rights
Human Rights, Universal Declaration of
Human Rights Watch
Jury
Magna Carta
Minority group
National Association for the Advancement of Colored People
Northern Ireland (The civil rights movement)
Open housing
Petition of Right
Political prisoner
Privacy, Right of
Racial profiling
Reconstruction (The Civil Rights Act)
Rights of Man, Declaration of the
Scottsboro Case
Search warrant
Second Amendment
Segregation
Sex discrimination
Sexual harassment
Student Nonviolent Coordinating Committee
Trial
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Voting
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Civil Rights, Commission on, is an independent agency of the United States government. It works to guarantee the civil rights of women and of American Indians, African Americans, and members of other minority groups. The commission attempts to protect voting rights and the right to equal opportunities in education, employment, housing, and other areas. It also investigates charges of denial of civil rights; studies how government policies affect such rights; and makes recommendations to the president and to Congress.

The commission was created in 1957. It originally contained six members. Congress expanded the commission to eight members in 1983. The president appoints four members, and the *president pro tempore* (temporary president) of the U.S. Senate and the speaker of the U.S. House of Representatives each appoint two. Commissioners serve six-year terms and may not be dismissed for their political opinions. No more than four members may belong to the same political party.

Jacob Cohen

Civil Rights Act of 1866. See **Reconstruction** (The Civil Rights Act).

Civil Rights Act of 1964 is a United States law that bans discrimination because of a person's color, race, national origin, religion, or sex. The act primarily protects the rights of blacks and other minorities. It is one of the nation's strongest civil rights laws.

The rights protected by the act include a person's freedom to seek employment; vote; and use hotels, parks, restaurants, and other public places. An individual who is discriminated against by an employer can file a complaint with the Equal Employment Opportunity Commission (EEOC), which was established by the act. The EEOC will take the complaint to court. The U.S. Department of Justice handles other complaints of discrimination. Before the law was passed, people had to take such complaints to court themselves, but few could afford to do so.

The Civil Rights Act also forbids discrimination by any program that receives money from the federal government. The government may cut off financing for a program that does not end discriminatory policies or practices. In addition, the act authorizes the Office of Education (now the Department of Education) to direct school desegregation programs in areas specified by the government. The government can sue any school system that refuses to desegregate, or any system whose desegregation program it considers inadequate.

President John F. Kennedy proposed the act in 1963.

After Kennedy's assassination later that year, President Lyndon B. Johnson continued to support it. The law was passed after a 75-day *filibuster* (lengthy debate to block legislation) in the Senate. The debate was one of the longest in Senate history. Charles V. Hamilton

See also **Equal Employment Opportunity Commission; Civil Rights, Commission on.**

Civil Rights Act of 1968. See **Open housing.**

Civil rights movement. See **Civil rights.**

Civil service is a system that includes almost all of a government's civilian employees who are appointed rather than elected. The term is usually used for a system in which appointments are based on ability and good performance and not on political connections. Civil service systems exist at every level of government in most countries.

Civil service in the United States

In the United States, civil service systems operate at the federal, state, and local levels. For most positions, these systems seek to hire and promote the most qualified person. Hiring and promotion comes without regard to race, religion, gender, sexual *orientation* (inclination), or political loyalty.

Federal civil service employment provides jobs throughout the United States and in government offices abroad. A large majority of all federal civilian employees work in agencies of the government's executive branch. Such agencies include the Department of Defense and the United States Postal Service.

The federal civil service includes hundreds of occupations. For example, skilled artists and engravers design and print government maps, books, and currency. Plant and animal experts help improve the quality and nutritional value of foods. Engineers, scientists, and technicians conduct research on road materials, missiles, ceramics, and aviation safety devices. Air traffic controllers guide aircraft at airports.

Competitive service positions make up the vast majority of all U.S. civil service jobs. These positions are filled by written or oral examination or by evaluation of an applicant's education, training, and experience. Some exams include performance tests. The Office of Personnel Management helps the departments and other agencies manage the exams. The office compiles lists of qualified applicants. An agency with a job opening may then choose from among the highest scorers on the appropriate list.

In addition to taking a test, applicants must fill out an application form. For some positions, jobseekers must apply directly to the government agency that has an opening. For other positions, they must apply through the Office of Personnel Management.

When compiling lists of qualified applicants, the government gives extra points to veterans, disabled veterans, and certain dependents of veterans. Some people object to the policy of giving extra points to nondisabled veterans. They believe this practice works against women, who are much less likely to be veterans than are men and therefore less likely to get extra points. However, veterans claim that the hiring preference is an earned reward for their previous national service.

Some people have questioned whether civil service examinations always test job-related skills. Also, some people doubt whether the examinations are fair to members of minority groups. The government has tried to give special consideration to women and minorities to remedy past discrimination in hiring. However, some people claim such efforts result in discrimination against whites and men.

Jobseekers can get information about federal civil service exams from Federal Job Information Centers throughout the United States. State employment offices, local-government personnel offices, and many public libraries also have such information. In addition, the government advertises civil service exams in newspapers and in other media.

Excepted service positions are outside the scope of civil service laws because: (1) they have a high level of authority; (2) they require professional training; or (3) the work of the agency involved is specialized or involves access to secret information.

Presidential appointees, assistants to Cabinet members, and other top aides are appointed by the President and may be dismissed by the President at any time. This method of filling positions helps ensure that government leaders agree with the President's priorities. Such professionals as chaplains and attorneys are also in the excepted service.

Some federal agencies maintain a separate personnel system. These agencies include the Foreign Service, the Central Intelligence Agency (CIA), the Federal Bureau of Investigation (FBI), and the Government Accounting Office.

Pay. Career positions in the civil service are organized into *grades* (levels) and steps to assure similar pay for similar work. Under this arrangement, workers can easily identify opportunities for advancement within and across agencies. At the top of the structure is the Senior Executive Service, a corps of highly trained career managers. Members of the Senior Executive Service have less job security than other civil servants do, and they may be shifted from assignment to assignment as the need arises. However, they also may receive extra pay based on their performance.

Pay levels for civil service jobs correspond to the grades and steps. Extra compensation is sometimes added for uniforms, overtime, travel, and the higher cost of living in some areas of the country. The pay of office workers is reviewed annually. Mechanics and laborers are paid in accord with private-industry wage rates in the region where they work. Some federal workers may engage in *collective bargaining.* In such bargaining, representatives of management and the workers' union meet to establish wages and working conditions that are acceptable to both sides. However, the bargaining rights of federal workers are more restricted than those of nongovernment workers, and federal workers may not strike. Despite these restrictions, job security and generous health insurance, vacation, pension, and other benefits have traditionally attracted people to civil service work.

Limits on civil servants. In addition to limits on their rights to act through unions, federal employees must accept other restrictions that do not apply to other workers. For example, to avoid conflicts of interest, some civil service employees must disclose their sources of income. Former holders of excepted service jobs may not

do business with government agencies for a certain period after they leave their job. Most federal civil service workers can take an active role in political campaigns, political parties, or other groups while off-duty. But they may not run for elected office. More severe limitations are placed on employees of the Federal Bureau of Investigation and other federal workers whose jobs U.S. law considers "sensitive."

Management of the civil service system is divided between the Office of Personnel Management and the independent Merit Systems Protection Board. The Office of Personnel Management sets standards, administers civil service examinations, and recruits and trains government workers. The Merit Systems Protection Board guards against violations of the merit system. A special lawyer not attached to the board can prosecute individuals in the civil service system who violate the system's requirements. The independent Federal Labor Relations Authority oversees relations between the federal government and the unions of civil service employees.

State and local civil service. Almost all state and local governments have civil service systems that resemble the national system. Most systems effectively fill government jobs on the basis of merit rather than political connections. In some states and cities, however, politicians use "provisional appointments" and other techniques to award public jobs to their supporters.

Most employees of state and local governments belong to a union. Unions of such employees may have great political influence through their financial contributions, their volunteer work in campaigns, and their voting power. As a result, the union members often determine who their elected "boss"—the governor or mayor—will be. In most areas, strikes by public employees at the state and local levels are illegal. A majority of labor disputes involving civil servants are settled through *arbitration*—that is, the dispute is settled by a neutral third party whose decision is binding.

History. The earliest Presidents generally sought qualified individuals for jobs, though they tended to favor their own political supporters. By the mid-1820's, government jobs were commonly used as political rewards. An incoming President would dismiss a large number of government workers originally hired by the opposition party and replace them with members of his own party. This practice was done to enhance the President's control of the bureaucracy. It was based on the ideas that government work was not complicated and that all people in a democracy should be eligible for it. This practice also reflected the idea that "to the victor belong the spoils." It led to much corruption and was called the *spoils system* (see **Spoils system**).

Many people hired through the spoils system had little or no training for their work and no interest in it. Many were dishonest. As government activities grew, a serious need for qualified workers developed. The government passed laws in 1853 and 1855 requiring examinations for clerks to make sure that new employees would be qualified to do the work. In 1871, Congress gave the President authority to establish tests for people seeking government jobs. But this merit system ended in 1875 because Congress failed to fund the system.

Reform leaders continued to press for a more thorough merit system in the federal, state, and local governments. In 1881, Charles J. Guiteau, a disappointed office seeker, shot and killed President James A. Garfield. Garfield's death brought public demands for civil service reforms and led to a bill introduced by Senator George H. Pendleton of Ohio. The bill became the Civil Service Act of 1883. About the same time, New York and Massachusetts began merit programs.

The Civil Service Act called for examinations open to all citizens. It provided for selection of new workers from among those making the highest grades on these examinations. The law banned the firing or demoting of workers for political reasons. The Civil Service Act also relieved government workers from any obligation to give political service or payments. The act established the United States Civil Service Commission to enforce the law.

At first, the Civil Service Act covered only about 10 percent of the federal positions. By 1940, 90 percent of all federal jobs were covered. Additional laws sought to make civil service a true career service. They authorized advancement based on merit and granted benefits similar to those offered by progressive private employers. For example, the Retirement Act of 1920 set up a pension system for civil service workers. The Classification Act of 1923 provided that all executive department jobs in Washington, D.C., be analyzed and classified so that workers would be paid according to the requirements of their jobs. A law passed in 1940 extended the provisions of the Classification Act to many federal positions outside Washington, D.C. The Civil Service Reform Act of 1978 replaced the Civil Service Commission with the Office of Personnel Management and the Merit Systems Protection Board.

Civil service in other lands

The idea of a civil service based on merit has long been practiced in China. Modern civil service systems began to develop in Europe more than 200 years ago. Developing nations in Africa, Asia, and Latin America have also begun to operate modern civil service programs.

Germany has one of the oldest civil service systems in Western Europe. It dates from the Prussian system of the late 1700's. In France, the merit system occupies a strong position. Each local government unit must have its own merit system or accept the system developed for local administration by the national government. The British Civil Service Department operates the British system.

Canada set up its first examination system for government employees through the Civil Service Act of 1908. A law passed in 1918 extended the coverage of the Civil Service Act to most national government jobs. Canada's Treasury Board is responsible for the personnel policy of the national government. The independent Public Service Commission of Canada, accountable directly to Parliament, administers the national civil service system in accord with merit principles. Gerald Benjamin

See also **City government** (Civil service); **Government** (Obtaining a government job); **Hatch Political Activities Act**; **Pension** (Federal civilian pensions).

Civil Service Commission, United States. See Civil service (History).



Detail of *The Gettysburg Cyclorama of 'Pickett's Charge'* (1884), a painting by Paul Philippoteaux; Gettysburg National Military Park, Gettysburg, Pa. (Walter B. Lane)

The Battle of Gettysburg was fought between Union and Confederate forces at Gettysburg, Pa., in July 1863. The South's retreat, following terrible losses, marked a turning point in the Civil War. Never again would the Confederate Army be able to mount a major attack against the North.

Civil War

Civil War (1861-1865) took more American lives than any other war in history. It so divided the people of the United States that in some families brother fought against brother. The Civil War was between the Southern States, trying to preserve slavery and an agricultural way of life, and the Northern States, dedicated to a more modern way of life and to ending slavery. The terrible bloodshed left a heritage of grief and bitterness that declined only slowly and, even today, has not fully disappeared.

The Civil War is also known by such names as the War Between the States and the War of Secession. It started on April 12, 1861, when Southern troops fired on Fort Sumter, a U.S. military post in Charleston, S.C. The war ended four years later. On April 9, 1865, Confederate General Robert E. Lee surrendered his ragged army to Union General Ulysses S. Grant at Appomattox Court House, a small Virginia settlement. The other Confederate armies gave up soon after.

Probably far more people are interested in the Civil War era than in any other period in United States history. Interest in the war appeared soon after peace came. Veterans' organizations were formed, and later civilian discussion groups and clubs arose. Over the years, the Civil War has been the subject of numerous novels, histories, plays, poems, paintings, sculptures, songs, movies, and television programs. Civil War monuments stand in parks and squares of big cities and small towns. Battlefields and the homes and tombs of such people as President Abraham Lincoln, Confederate President Jefferson Davis, and Generals Lee and Grant are popular tourist sites. Some Civil War figures are among the nation's most beloved heroes. Lincoln in particular became a respected figure throughout the world.

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In 1861, the United States consisted of 19 *free states,* in which slavery was prohibited, and 15 *slave states,* in which it was allowed. Abraham Lincoln called the nation "a house divided." Americans had much in common, but the free and slave states also had many basic differences besides slavery.

Historians have long debated the causes of the Civil War. Many of them maintain that slavery was the root cause. In his second inaugural address in 1865, Lincoln said of slavery: "All knew that this interest was, somehow, the cause of the war." But most historians agree that the war had a number of causes. They note especially the *sectional division* between North and South—that is, the differences in economies, ideals, and ways of life. They also point to the disputes between the federal government and the states over what rights and powers the states possessed. Historians further mention the blunderings of politicians and the disorder in the American political party system during the 1850's. Yet all explanations for the causes of the war have always involved or revolved around the issue of slavery.

The sectional division

The sectional division between North and South began in colonial times and resulted from geographical differences. In the South, the earliest settlers found the warm climate and fertile soil ideal for growing tobacco. They started many tobacco plantations and brought in black slaves from Africa to provide most of the labor. In time, other plantation crops, especially cotton, sugar cane, and sugar beets, were found to thrive in the South. The South thus quickly established a rural way of life supported by an agricultural economy based on slave labor.

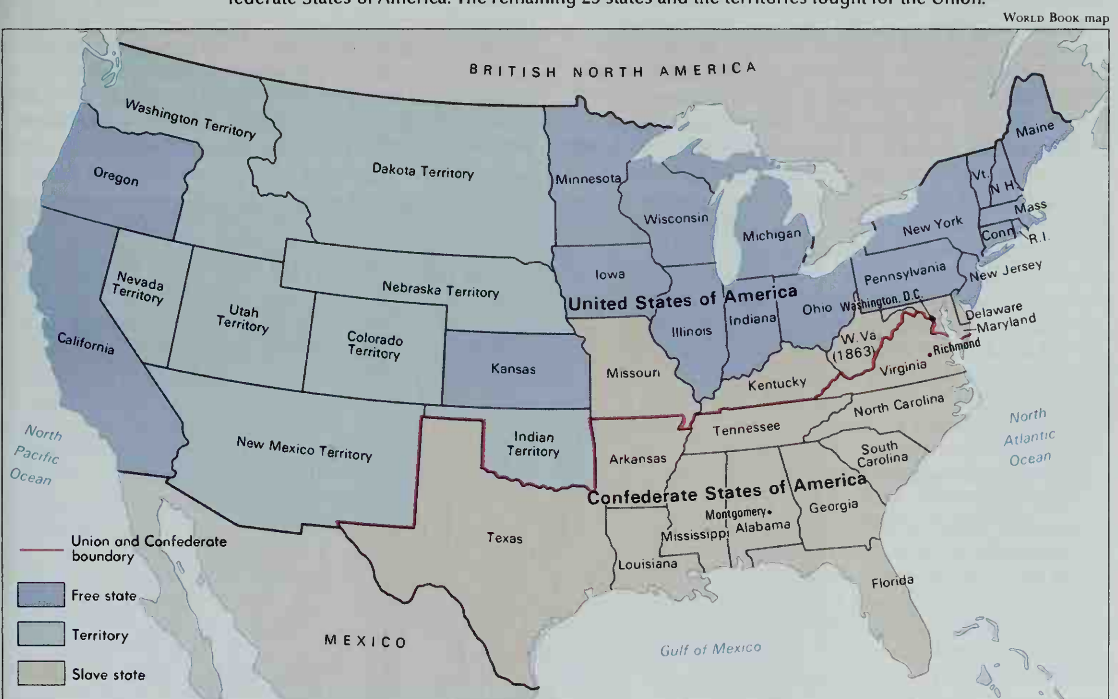
The cooler climate and rocky soil in the North were not suitable for establishing plantations or large farms. As a result of those and other factors, the North's economy came to depend more on trade than on agriculture. Such an economy favored the growth of cities, though most Northerners still lived in rural areas during the colonial period.

The sectional division between North and South had widened enormously by the mid-1800's. By that time, the United States had expanded all the way to the Pacific Ocean and was rapidly becoming a major industrial and commercial nation. However, industry and commerce were centered in the North. Many factories using mass-production methods had sprung up there, and cities grew rapidly. Great advances in transportation and communication aided the economic growth.

The Northerners, or *Yankees* (a name applied to the Northerners by U.S. Southerners), welcomed modernization and the constant changes it brought to their way of life. The ideals of Yankee Protestantism encouraged modernization. Those ideals included hard work, education, economic independence, and the belief that the community had the right and responsibility to decide whether an action was moral or immoral. While Northerners looked forward to a different and better future, Southerners held the present and past dear. They

The divided nation Before the start of the Civil War in 1861, the United States consisted of 19 free states, 15 slave states, and several territories. Eleven slave states withdrew from the Union and made up the Confederate States of America. The remaining 23 states and the territories fought for the Union.

World Book map



enjoyed a prosperous agricultural economy based on slave labor and wished to keep their old way of life.

The conflict over slavery

In colonial times, most Americans regarded slavery as a necessary evil. The Founding Fathers of the United States had been unable to abolish slavery and compromised over it in writing the Constitution (see **Constitution of the United States** [The compromises]).

By the early 1800's, many Northerners had come to view slavery as wrong. Abolitionists in the North began a movement to end it. An antislavery minority also existed in the South. But most Southerners found slavery to be highly profitable and in time came to consider it a positive good. From a fourth to a third of all Southern whites were members of slaveholding families. About half the families owned fewer than 5 slaves, though less than 1 per cent of the families owned 100 or more. Even many of the white Southerners who did not own slaves supported slavery. They accepted the ideas that the South's economy would collapse without slavery and that blacks were inferior to whites.

In 1858, Senator William H. Seward of New York, who later became Lincoln's secretary of state, referred to the differences between North and South as "an irrepressible conflict." He placed slavery at the heart of that uncontrollable conflict. Indeed, an almost continuous series of debates over slavery raged in Congress between Northern and Southern lawmakers during the 1850's.

The Compromise of 1850 was a group of acts passed by Congress in the hope of settling the slavery question by giving some satisfaction to both the North and the South. The Compromise allowed slavery to continue but prohibited the slave trade in Washington, D.C. It admitted California to the Union as a free state but gave newly acquired territories the right to decide for themselves whether to permit slavery. The Compromise also included a strict fugitive slave law that required Northerners to return escaped slaves to their owners.

Northerners resisted the fugitive slave law in several ways. Abolitionists disobeyed the law by operating the *underground railroad,* a system of escape routes and housing for runaway slaves. The routes led from the slave states to the free states and Canada. Abolitionists also rescued or tried to rescue fugitive slaves after they had been recovered in the North by their owners. A number of rescue attempts, such as those in Christiana, Pa., in 1851 and in Boston in 1854, resulted in riots and several deaths. One of the most effective attacks on the fugitive slave law—and on slavery as a whole—was Harriet Beecher Stowe's best-selling antislavery novel *Uncle Tom's Cabin* (1851-1852).

The Kansas-Nebraska Act was passed by Congress in 1854. Like the Compromise of 1850, it dealt with the problem of slavery in new territories. The act created the territories of Kansas and Nebraska and allowed slavery in them. The act also provided that when the people of each territory organized as a state, they could decide by popular vote whether to permit slavery to continue. The decision process was called *popular sovereignty.* Many Northerners opposed the act. They feared that once slavery was in a territory, it was there to stay.

The first test of popular sovereignty came in Kansas, where a majority of the population voted against becoming a slave state. However, proslavery forces refused to accept the decision. The situation quickly erupted into violence. The violence spread to Washington, D.C., where in 1856 an antislavery senator, Charles Sumner of Massachusetts, was beaten unconscious by Preston Brooks, a proslavery representative from South Carolina. In the end, Kansas joined the Union as a free state in 1861.

The Dred Scott Decision. In 1857, the Supreme Court of the United States tried to settle the slavery issue with its Dred Scott Decision. The case involved Dred Scott, a slave who claimed freedom because he had lived for a time in a free state and territory. The court denied Scott's claim and declared that no black could be a United States citizen. It further ruled that Congress could not prohibit slavery in the territories. The ruling aroused anger in the North and showed that the conflict over slavery was beyond judicial solutions.

The raid at Harpers Ferry. In 1859, an extreme abolitionist named John Brown and his followers attempted to start a slave rebellion by seizing the federal arsenal in Harpers Ferry, Va. (now W. Va.). Brown was captured 28 hours later by troops under Colonel Robert E. Lee. Within a few weeks, he was convicted of treason and hanged. Many Southerners saw the raid as evidence of a Northern plot to end slavery by force.

Developments in the political party system

Anger over the Kansas-Nebraska Act led to the founding of the Republican Party in the North in 1854. The Republicans considered slavery evil and opposed its extension into Western territories. Many Whigs and Democrats—members of the nation's two largest parties—joined the new party. They included Abraham Lincoln, a former Whig. Some other Americans belonged to the Know-Nothing Party, which blamed immigrants and Roman Catholics for the country's problems. The Republican Party's first presidential candidate, John C. Frémont, won most of the Northern vote and almost the presidency in 1856.

In 1858, the Democratic Party was divided over a constitution that proslavery Kansans hoped to have adopted when the Kansas territory became a state. Two of the party's leaders, Senator Stephen A. Douglas of Illinois and President James Buchanan, took opposite positions on the constitution. Douglas opposed it, and Buchanan favored it. The conflict between proslavery and antislavery Democrats caused the party to split into Northern and Southern branches in 1860.

The Republicans chose Lincoln as their candidate in the 1860 presidential election. Douglas ran on the Northern Democratic ticket. Vice President John C. Breckinridge was the Southern Democratic candidate. Some former members of the Whig and Know-Nothing parties—which had disbanded by 1860—formed the Constitutional Union Party and nominated former Senator John Bell of Tennessee.

Lincoln won all the electoral votes of every free state except New Jersey, which awarded him four of its seven votes. He thus gained a majority of electoral votes and

won the election. However, Lincoln received less than 40 per cent of the popular vote, almost none of which came from the South. Southerners feared Lincoln would restrict or end slavery.

Secession

Before the 1860 presidential election, Southern leaders had urged that the South *secede* (withdraw) from the Union if Lincoln should win. Many Southerners favored secession as part of the idea that the states have rights and powers which the federal government cannot legally deny. The supporters of states' rights held that the national government was a league of independent states, any of which had the right to secede.

In December 1860, South Carolina became the first state to secede. Five other states—Mississippi, Florida, Alabama, Georgia, and Louisiana—followed in January 1861. In February, representatives from the six states met in Montgomery, Alabama, and established the Confederate States of America. They elected Jefferson Davis of Mississippi as president and Alexander H. Stephens of Georgia as vice president of the Confederate States. In March, Texas joined the Confederacy. Lincoln was inaugurated two days later.

In his inaugural address, Lincoln avoided any threat of immediate force against the South. But he stated that the Union would last forever and that he would use the nation's full power to hold federal possessions in the South. One of the possessions, the military post of Fort Sumter, lay in the harbor of Charleston, South Carolina. The Confederates fired on the fort on April 12 and forced its surrender the next day. On April 15, Lincoln called for Union troops to regain the fort. The South regarded the move as a declaration of war. Virginia, Arkansas, North Carolina, and Tennessee soon joined the Confederacy.

Virginia had long been undecided about which side to join. Its decision to join the Confederacy boosted Southern morale. Richmond, Virginia's capital, became the capital of the Confederacy in May.

Mobilizing for war

When the Civil War began, about 22 million people lived in the North. About 9 million people, including $3\frac{1}{2}$ million slaves, lived in the South. The North had around 4 million men from 15 through 40 years old—the approximate age range for combat duty. The South had only about 1 million white men in that range. The North began to use black soldiers in 1863. The South did not use blacks as soldiers until the war's closing days.

How the states lined up

Eleven states fought for the Confederacy. They were Alabama, Arkansas, Florida, Georgia, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, Texas, and Virginia. Twenty-three states fought for the Union. They were California, Connecticut, Delaware, Illinois, Indiana, Iowa, Kansas, Kentucky, Maine, Maryland, Massachusetts, Michigan, Minnesota, Missouri, New Hampshire, New Jersey, New York, Ohio, Oregon, Pennsylvania, Rhode Island, Vermont, and Wisconsin. The territories of Colorado, Dakota, Nebraska, Nevada, New Mexico, Utah, and Washington also fought for the Union.

Each side included slave states that lay on either side of the border between the North and the Deep South. Some people in those *border states* supported the North, but others believed in the Southern cause. The heaviest fighting of the war occurred in the border states. Border states on the Southern side were Virginia, North Carolina, Tennessee, and Arkansas. However, Virginians in the western part of the state remained loyal to the Union and formed the new state of West Virginia in 1863. Border states that stayed in the Union were Delaware, Maryland, Kentucky, and Missouri. But secession-

Bombardment of Fort Sumter, Charleston Harbor, a color lithograph by Currier & Ives (SCALA/Art Resource)



Fort Sumter, in Charleston Harbor, was the site of the first battle of the Civil War. Confederate troops under the command of General Pierre G. T. Beauregard attacked the U.S. Army post on April 12, 1861. The Union defenders surrendered to the rebels on April 13 and withdrew from the fort on April 14.

ist groups in Kentucky and Missouri set up separate state governments and sent representatives to the Confederate Congress.

In both the North and the South, some families were torn by divided loyalties to the Union and the Confederacy. One of Kentucky Senator John J. Crittenden's sons, Thomas, became a Union general. Another son, George, became a Confederate general. George H. Thomas, one of the Union's best generals, was born in Virginia. Admiral David Farragut, who defeated Southern forces at New Orleans and Mobile Bay, was born in Tennessee. Three half brothers of Mary Todd Lincoln, Lincoln's wife, died fighting for the Confederacy. The husband of one of her half sisters was a Confederate general who was also killed.

Building the armed forces

At the beginning of the Civil War, neither the North nor the South had a plan to call up troops. The Regular Army of the United States at that time consisted of only about 16,000 men, most of whom fought for the North. Both sides tried to raise their armies by appealing to volunteers. That system worked at first. Individual states, rather than the Union or Confederate governments, recruited most volunteers and often equipped them. Any man who wanted to organize a company or a regiment could do so. In the North, especially late in the war, volunteers often received a *bounty* (payment for enlisting). The bounty system encouraged thousands of *bounty jumpers,* who deserted after being paid. Many bounty jumpers enlisted several times, often using a different name each time.

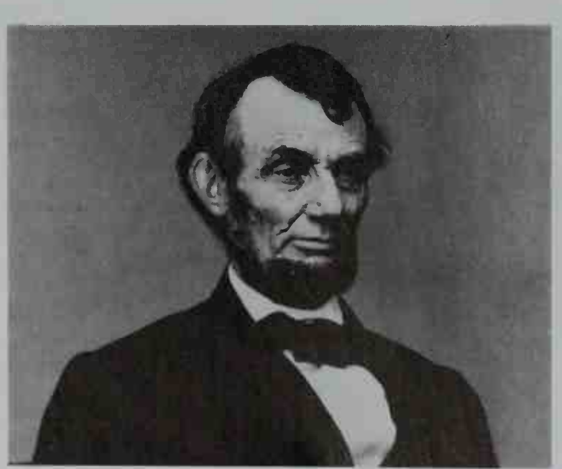
The draft. As the Civil War went on, enthusiasm for it faded and volunteer enlistments decreased. Both sides then tried drafting soldiers. The first Southern draft law was passed in April 1862 and made all able-bodied white men from ages 18 through 35 liable for three years' service. By February 1864, the limits had been changed to 17 and 50. The Northern program, begun in March 1863, drafted men from ages 20 through 45 for three years. Exceptions to the draft were made in the North and South, however, and both sides allowed a draftee to pay a substitute to serve for him. In addition, a draftee in the North could pay the government $300 to avoid military service. The system seemed unfair, and many soldiers grumbled that they were involved in "a rich man's war and a poor man's fight." But on the whole, both armies had a fair representation of soldiers from the various social groups of their regions.

The draft worked poorly and was extremely unpopular in many areas of both North and South. In some isolated hill country of the South, it could not be enforced. In July 1863, armed antidraft protesters in New York City set fire to buildings and took over parts of the city before police and the Army restored order. However, the Northern and Southern draft succeeded in its main purpose, which was to stimulate volunteering.

No one knows exactly how many men served in the Civil War. The totals on both sides included many short-term enlistments and *repeaters* (men who served more than once). According to the best estimates, 2,100,000 men served in the Union Army, and 800,000 men served in the Confederate Army. A little more than half the men of military age served for the North. A larger proportion of eligible men—almost four-fifths—served for the South. In the South, black slaves performed most of the labor, thereby freeing a greater percentage of eligible whites for military duty. Immigrants made up about 24 per cent of the Union Army and about 10 per cent of the Confederate Army.

The Confederate Army reached peak strength in 1863, then declined. But the Union Army grew. In the last year of the war, the North had over a million soldiers. The South probably had no more than 200,000. About 10 per cent of the soldiers on both sides deserted. Desertion from the Confederate Army became most common in the last months of the war, when Southern morale began to collapse and defeat seemed certain.

The commanding officers. As commander in chief of the U.S. armed forces, Abraham Lincoln had to



Library of Congress

Abraham Lincoln was President of the United States during the Civil War. His strong leadership helped preserve the Union and led to the end of slavery throughout the nation.



Granger Collection

Jefferson Davis served as president of the Confederate States during the Civil War. He was firmly dedicated to the Southern cause but lacked the North's resources.

choose the Union's top military officers. Jefferson Davis had the same task in the Confederacy. Davis fortunately had General Robert E. Lee to take command of the Eastern Confederate Army. Lee's able officers included Generals Stonewall Jackson and James Longstreet. Confederate commanders in the West—Generals Albert Sidney Johnston, Pierre G. T. Beauregard, Braxton Bragg, and Joseph E. Johnston—were less successful.

Lincoln tried several commanders for the Eastern Union Army, which came to be called the Army of the Potomac. They were, in turn, Generals Irvin McDowell, George B. McClellan, John Pope, McClellan again, Ambrose E. Burnside, Joseph Hooker, and George G. Meade. All had serious weaknesses. Lincoln's Western generals—Henry W. Halleck, Don Carlos Buell, and William S. Rosecrans—also failed to meet his expectations. But as the war progressed, four outstanding generals emerged to lead the Union armies to victory. They were Ulysses S. Grant, William T. Sherman, Philip H. Sheridan, and George H. Thomas.

Leading Civil War generals

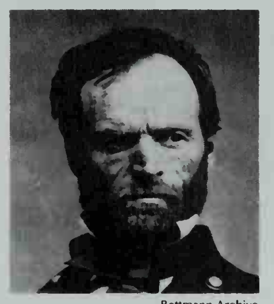


National Archives

Ulysses S. Grant (North)

Valentine Museum, Richmond, Va.

Robert E. Lee (South)



Bettmann Archive

William T. Sherman (North)



Bettmann Archive

Stonewall Jackson (South)

Major Civil War weapons

Civil War soldiers used the first *breech-loading rifles,* which were loaded at the *breech* (rear) of the barrel instead of the muzzle. *Mortars* fired cannonballs in a high arc. *Rifled-barrel cannons* had spiral grooves inside the barrel that sent cannonballs spinning accurately toward targets.



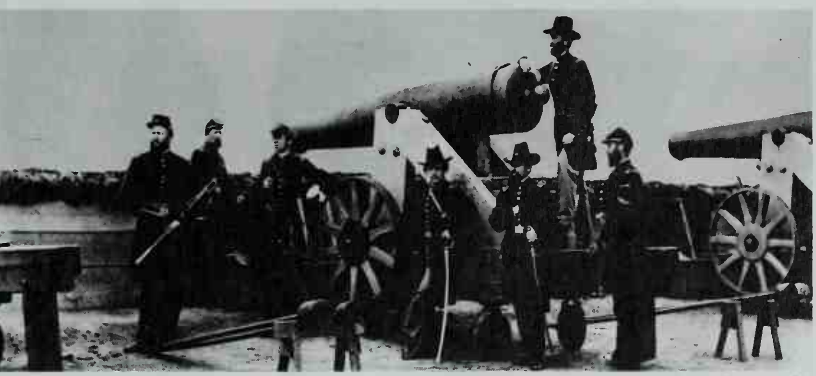
Chicago Historical Society

Breech-loading rifle



Chicago Historical Society

Mortar mounted on a railroad flatcar



Chicago Historical Society

Rifled-barrel cannon mounted on wheels

The enlisted men. Civil War soldiers were much like American enlisted men of earlier and later wars. They fought well but remained civilians, with a civilian's dislike of military rules. In most regiments, the men all came from the same area. Many units elected their own officers. Northern troops called the Southern soldier *Johnny Reb* or *Reb,* after *rebel.* Southerners called the enemy *Billy Yank* or *Yank.*

Civil War soldiers received more leaves and furloughs than did soldiers of previous wars, and they had better food and clothing. But compared with today's standards, they had a hard life. Both sides paid their soldiers poorly. Food supplies consisted mainly of flour, cornmeal, beef, beans, and dried fruit. Many soldiers made their own meals. Armies on the march ate salt pork and hard biscuits called *hardtack.* Poorly made clothing of *shoddy* (rewoven wool) often fell apart in the first storm. Southern soldiers at times lacked shoes and had to march and fight barefoot.

Most Civil War soldiers carried muzzleloading rifles. Because the guns could fire only one shot at a time, they seem primitive today. But they had an accurate range of nearly 400 yards (366 meters), far longer than earlier muskets. Civil War infantrymen often marched in close-order formation, as soldiers had done in other wars, and so were an easy target. A determined force in a strong position could resist almost any head-on attack by men approaching in close-order formation.

Many Civil War battles took a terrible toll in human lives. An army often had 25 per cent of its men killed, wounded, captured, or otherwise lost in a major battle. Among some regiments at the Battle of Gettysburg and other battles, the death rate alone ran as high as 25 per cent or more. The heavy death toll led Civil War soldiers to devise the first dog tags for identification in case they were killed. A soldier would print his name and address on a handkerchief or a piece of paper and pin it to his uniform before going into battle.

Uniforms of the Civil War

At the start of the Civil War, the militia units that largely made up the Union and Confederate armies wore a variety of uniforms. Both sides soon established regulation uniforms, such as the Union blue and Confederate gray examples shown below. But certain regiments called *zouaves* wore distinctive Oriental-style uniforms throughout the war.

WORLD BOOK illustration by H. Charles McBarron, Jr.

North

Cavalry Corporal in Winter Overcoat

Infantry Private

Cavalry Captain in Full-Dress Uniform

Navy Captain

Seaman

Zouave of the 5th New York Infantry

South

Cavalry Sergeant, 1862

Infantry Private, 1861-1862

Infantry Private, 1863-1865

Navy Captain

Seaman

Artillery Gunner

Early black participation. Early in the war, Northern blacks who wanted to fight to end slavery tried to enlist in the Union Army. But the Army rejected them. Most whites felt the war was a "white man's war."

As Northern armies drove into Confederate territory, slaves flocked to Union camps. After a period of uncertainty, the Union government decided to allow them to perform support services for the Northern war effort. In time, as many as 200,000 blacks worked for Union armies as cooks, laborers, nurses, scouts, and spies.

The Emancipation Proclamation. Black leaders, such as the former slave Frederick Douglass of New York, saw the Civil War as a road to *emancipation* (freedom) for the slaves. However, the idea of emancipation presented problems in the North. For one thing, the Constitution recognized slavery. In addition, most Northerners—even though they may have opposed slavery—were convinced of black inferiority. Many of them feared that emancipation would cause a mass movement of Southern blacks into the North. Northerners also worried about losing the border states loyal to the Union because those states were strongly committed to slavery. Skillful leadership was needed as the country moved toward black freedom. Lincoln supplied that leadership by combining a clear sense of purpose with a sensitivity to the concerns of various groups.

On Sept. 22, 1862, Lincoln issued a preliminary order to free the slaves. It declared that all slaves in states in rebellion against the Union on Jan. 1, 1863, would be forever free. It did not include slave states loyal to the Union. On Jan. 1, 1863, Lincoln issued the final order as the Emancipation Proclamation. The Emancipation Proclamation, though legally binding, was a war measure that could be reversed later. Therefore, in 1865, Lincoln helped push through Congress the 13th Amendment to the Constitution, which abolished slavery throughout the nation. For his effort in freeing the slaves, Lincoln is known as the "Great Emancipator."

The use of black troops. The Emancipation Proclamation also announced Lincoln's decision to use black troops, though many whites believed that blacks would make poor soldiers. About 180,000 blacks served in the Union Army. Two-thirds of them were Southerners who had fled to freedom in the North. About 20,000 blacks

Important events during the Civil War

1861

April 12 Confederate troops attacked Fort Sumter.
April 15 Lincoln issued a call for troops.
April 19 Lincoln proclaimed a blockade of the South.
May 21 Richmond, Va., was chosen as the Confederate capital.
July 21 Northern troops retreated in disorder after the First Battle of Bull Run (Manassas).

1862

Feb. 6 Fort Henry fell to Union forces.
Feb. 16 Grant's troops captured Fort Donelson.
March 9 The ironclad ships *Monitor* and *Merrimack (Virginia)* battled to a draw.
April 6-7 Both sides suffered heavy losses in the Battle of Shiloh, won by the Union.
April 16 The Confederacy began to draft soldiers.
April 18-25 Farragut attacked and captured New Orleans.
May 4 McClellan's Union troops occupied Yorktown, Va., and advanced on Richmond.
May 30 Northern forces occupied Corinth, Miss.
June 6 Memphis fell to Union armies.
June 25-July 1 Confederate forces under Lee saved Richmond in the Battles of the Seven Days.
Aug. 27-30 Lee and Jackson led Southern troops to victory in the Second Battle of Bull Run.
Sept. 17 Confederate forces retreated in defeat after the bloody Battle of Antietam (Sharpsburg).
Sept. 22 Lincoln issued a preliminary Emancipation Proclamation.
Oct. 8 Buell's forces ended Bragg's invasion of Kentucky in the Battle of Perryville.
Dec. 13 Burnside's Union forces received a crushing blow in the Battle of Fredericksburg.
Dec. 31-Jan. 2, 1863 Union troops under Rosecrans forced the Confederates to retreat after the Battle of Stones River (Murfreesboro).

1863

Jan. 1 Lincoln issued the Emancipation Proclamation.
March 3 The North passed a draft law.
May 1-4 Northern troops under Hooker were defeated in the Battle of Chancellorsville.
May 1-19 Grant's army defeated the Confederates in Mississippi and began to besiege Vicksburg.
July 1-3 The Battle of Gettysburg ended in a Southern defeat and marked a turning point in the war.
July 4 Vicksburg fell to Northern troops.
July 8 Northern forces occupied Port Hudson, La.
Sept. 19-20 Southern troops under Bragg won the Battle of Chickamauga.
Nov. 19 Lincoln delivered the Gettysburg Address.
Nov. 23-25 Grant and Thomas led Union armies to victory in the Battle of Chattanooga.

1864

March 9 Grant became general in chief of the North.
May 5-6 Union and Confederate troops clashed in the Battle of the Wilderness.
May 8-19 Grant and Lee held their positions in the Battle of Spotsylvania Court House.
June 3 The Union suffered heavy losses on the final day of the Battle of Cold Harbor.
June 20 Grant's troops laid siege to Petersburg, Va.
July 11-12 Early's Confederate forces almost reached Washington but retreated after brief fighting.
Aug. 5 Farragut won the Battle of Mobile Bay.
Sept. 2 Northern troops under Sherman captured Atlanta.
Sept. 19-Oct. 19 Sheridan led his troops on a rampage of destruction in the Shenandoah Valley.
Nov. 8 Lincoln was reelected President.
Nov. 15 Sherman began his march through Georgia.
Nov. 23 Hood invaded Tennessee.
Nov. 30 Schofield's Union forces inflicted heavy losses on Hood in the Battle of Franklin.
Dec. 15-16 The Battle of Nashville smashed Hood's army.
Dec. 21 Sherman's troops occupied Savannah, Ga.

1865

Feb. 6 Lee became general in chief of the South.
April 2 Confederate troops gave up Petersburg and Richmond.
April 9 Lee surrendered to Grant at Appomattox.
April 14 Lincoln was assassinated.
April 26 Johnston surrendered to Sherman.
May 4 Confederate forces in Alabama and Mississippi surrendered.
May 11 Jefferson Davis was captured.
May 26 The last Confederate troops surrendered.



Black troops fought in nearly 500 Civil War engagements. Twenty-three blacks won the Medal of Honor, the highest U.S. military award, for heroism. Nearly all black soldiers served in the Union Army. They were organized into segregated units like this one.

Bettmann Archive

served in the Union Navy, which had been open to blacks long before the war. Black troops formed 166 all-black regiments, most of which had white commanders. Only about 100 blacks were made officers.

Blacks fought in nearly 500 Civil War engagements, including 39 major battles. About 35,000 black servicemen lost their lives. Altogether, 23 blacks won the Medal of Honor, the nation's highest military award, for heroism. A black regiment was one of the first Northern units to march into Richmond after it fell. Lincoln then toured the city, escorted by black cavalry.

At first, black soldiers received only about half the pay of white soldiers and no bounties for volunteering. In 1864, Congress granted blacks equal pay and bounties. However, other types of official discrimination continued. For example, most black soldiers were allowed to perform only noncombat duties. But some blacks who had the opportunity to go into combat distinguished themselves. The bravery of blacks in the 1863 Mississippi Valley campaign surprised most Northerners. But protests against the use of black troops went on.

Later in 1863, the 54th Massachusetts Volunteers—the first black troops from a free state to be organized for combat in the Union Army—stormed Fort Wagner in Charleston Harbor. Their bravery turned the tide of Northern public opinion to accept black troops. Lincoln wrote that when peace came "there will be some black men who can remember that, with silent tongue, and clenched teeth, and steady eye, and well-poised bayonet, they have helped mankind on to this great consummation; while, I fear, there will be some white ones, unable to forget that, with malignant heart, and deceitful speech, they have strove to hinder it."

Reaction in the South. The Confederacy objected strongly to the North's use of black soldiers. The Confederate government threatened to kill or enslave any captured officers or enlisted men of black regiments. Lincoln replied by promising to treat Confederate prisoners of war the same way. Neither side carried out its threats, but the exchange of prisoners broke down mainly over the issue of black prisoners.

The North's success in using black soldiers slowly led Southerners to consider doing the same. In the spring of 1865, following a strong demand by General Lee, the Confederate Congress narrowly approved the use of black soldiers. However, the war ended soon thereafter.

The home front

The Civil War became the first war to be completely and immediately reported in the press to the people back home. Civilians in the North were especially well informed of the war's progress. Northern newspapers sent their best correspondents into the field and received their reports by telegraph. Winslow Homer and many other artists and illustrators produced war scenes for such magazines as *Harper's Weekly.* Mathew Brady, Alexander Gardner, and other pioneer photographers captured the horrors of the battlefield and the humanity of the soldiers in thousands of news pictures.

The Civil War inspired a flood of patriotic songs. Northern civilians and soldiers sang such songs as "The Battle Cry of Freedom," "Marching Through Georgia," and "John Brown's Body." Early in the war, Julia Ward Howe wrote "The Battle Hymn of the Republic" to the tune of "John Brown's Body." Southern soldiers marched to war to the stirring music of "Dixie" and "The Bonnie Blue Flag." Some Northern songs, such as "Tenting on the Old Camp Ground" and "When Johnny Comes Marching Home," also became popular in the South. And some Southern songs—for example, the mournful "Lorena" and "All Quiet Along the Potomac Tonight"—were also popular in the North.

In the North

Government and politics. After the attack on Fort Sumter, Lincoln boldly ordered troops to put down the rebellion, increased the size of the U.S. Army, proclaimed a naval blockade of the South, and spent funds without congressional approval. He became the first President to assume vast powers not specifically granted by the Constitution. He suspended the right known as *habeas corpus* in many cases in which people opposed the war effort. Habeas corpus guarantees a person under arrest a chance to be heard in court. Its suspension received bitter criticism. Yet many traditional American freedoms continued to flourish, even though the nation was in the midst of a civil war.

Opposition to the war and Lincoln's policies came

chiefly from the Democratic Party, especially from a group known as the Peace Democrats, who wanted the war stopped. Republicans considered the Peace Democrats disloyal and treacherous and called them Copperheads, after the poisonous snake. Other protesters of the war joined secret antigovernment societies, such as the Knights of the Golden Circle. The Lincoln Administration was also criticized by so-called Radical Republicans. They wanted the government to move more rapidly to abolish slavery and to make sweeping changes in the Southern way of life. Such disputes continued throughout the war.

Economy. The Civil War brought booming prosperity to the North. Government purchases for military needs stimulated manufacturing and agriculture. The production of coal, iron and steel, weapons, shoes, and woolen clothing increased greatly. Farmers vastly expanded their production of wheat, wool, and other products. Exports to Europe of beef, corn, pork, and wheat doubled. Factories and farms made the first widespread use of labor-saving machines, such as the sewing machine and the reaper.

Although the Civil War brought prosperity to the North, financing the war was difficult. Taxes and money borrowed through the sale of war bonds became major sources of income. The government also printed more paper money to meet its financial needs. But by increasing the money supply, the government promoted inflation. Wages did not keep up with inflation through much of the war, and factory workers struck for higher pay. But as the war went on, war production—and finally victory—helped the North grow ever stronger.

During the Lincoln Administration, Congress passed the most important series of economic acts in American history to that time. It established the national banking system, a *uniform* (standard) currency, and the Department of Agriculture. The Pacific Railroad Act of 1862 provided for the building of the nation's first transcontinental rail line. The Homestead Act of 1862 granted settlers public land in the West free or at low cost. The Land-Grant, or Morrill, Act of 1862 helped states establish agricultural and technical colleges. Under Lincoln, Congress also passed the first federal income tax. Altogether, the economic progress in the North brought about by and during the Civil War helped put the United States on the road to becoming the world's greatest industrial power by the late 1800's.

In the South

Government and politics. During the Civil War, the South tried to bring political power under the control of a single authority. But it was not very successful. Southerners had long opposed a strong central government. During the war, some of them found it difficult to cooperate with officials of both the Confederacy and their own states and cities. States' rights supporters backed the war but opposed the draft and other actions needed to carry it out. And Jefferson Davis lacked Lincoln's leadership abilities. For example, Lincoln believed he had the power to suspend the law if necessary, and he did so. Davis asked the Confederate Congress for such power but received only limited permission.

Economy. As in the North, manufacturing and agriculture in the South were adapted to the needs of war. Factories converted from civilian to wartime production. For example, the Tredegar Iron Works in Richmond became the South's main source of cannons. Cotton cultivation dropped sharply, while food production was greatly increased.

The South thus tried to adjust to meet wartime needs, but its economy became strained almost to the breaking point. The attempt to finance the war by taxation and borrowing from the people failed. The Confederacy's solution to the problem was to print large amounts of paper money, which led to an extremely high inflation rate. By the end of the war, prices were 10 times higher than they were at the start. In 1865, flour cost up to $300 a barrel, and shoes $200 a pair. In time, Southerners had to make clothes of carpets and curtains and print newspapers on the back of wallpaper.

Confederate troops were never as well equipped as their Northern foes. As resources were used up and the tightening naval blockade severely reduced imports, matters got worse. The Confederate government then passed the Impressment Act of 1863. The act permitted government agents to seize from civilians food, horses, and any other supplies the Army needed. The civilians received whatever the agents decided to pay.

Relations with Europe. At the beginning of the Civil War, Southern leaders hoped that European countries—especially Great Britain and France—would come to the aid of the Confederacy. Southerners believed that Britain and France would be forced to support the Confederacy because their textile industries depended on Southern cotton. The efforts of Southern statesmen to persuade the European powers to help the Confederacy came to be called "cotton diplomacy."

As a result of cotton diplomacy, Britain and France allowed the Confederacy to have several armed warships built in their shipyards. But the South never won Euro-



Library of Congress

Magazine illustrators, as well as reporters and photographers, traveled to Civil War battlegrounds. Alfred R. Waud, a *Harper's Weekly* artist, is shown sketching at Gettysburg.

pean recognition of the Confederacy as an independent nation or obtained major aid. Northern grain had become important in Europe, which had suffered several crop failures. At the same time, Southern cotton was increasingly replaced by cotton from India and Egypt. The Emancipation Proclamation made the Civil War a fight against slavery. The proclamation deeply impressed those Europeans who opposed slavery. Such skillful Northern diplomats as Charles Francis Adams also helped persuade the European powers not to recognize the Confederacy. But most important, Britain and France would not fight on the side of the South unless the Confederacy could show that it might win final victory. And that never happened.

Major battles of the Civil War

			Commanders		Casualties*		
Battle	**State**	**Date**	**North**	**South**	**North**	**South**	**Results**
Antietam (Sharpsburg)	Md.	Sept. 17, 1862	McClellan	Lee	12,500	13,700	Confederate retreat gave Lincoln the occasion to announce the preliminary Emancipation Proclamation.
Bull Run (Manassas) First	Va.	July 21, 1861	McDowell	Beauregard	3,000	2,000	The North first realized the seriousness of the war.
Second		Aug. 27-30, 1862	Pope	Lee	16,100	9,200	The South regained almost all of Virginia.
Chancellorsville	Va.	May 1-4, 1863	Hooker	Lee	16,800	12,800	Confederate forces were victorious, but Stonewall Jackson was killed.
Chattanooga	Tenn.	Nov. 23-25, 1863	Grant	Bragg	5,800	7,700	Union win put most of Tennessee in Northern hands.
Chickamauga	Ga.	Sept. 19-20, 1863	Rosecrans	Bragg	16,200	18,500	Southern victory trapped Rosecrans in Chattanooga.
Cold Harbor	Va.	June 1-3, 1864	Grant	Lee	12,000	1,500	Heavy losses forced Grant to change his tactics.
Fair Oaks (Seven Pines)	Va.	May 31-June 1, 1862	McClellan	J. Johnston	5,000	6,000	Confederate forces were driven back.
Fort Donelson	Tenn.	Feb. 13-16, 1862	Grant	Buckner	2,800	15,800	The North won its first important victory.
Fort Henry	Tenn.	Feb. 6, 1862	Grant	Tilghman	50	20	Initial success encouraged Grant's Western campaign.
Franklin	Tenn.	Nov. 30, 1864	Schofield	Hood	2,300	6,300	Hood's Tennessee campaign failed to draw Sherman from Georgia.
Fredericksburg	Va.	Dec. 13, 1862	Burnside	Lee	12,700	5,300	A terrible defeat left the North discouraged.
Gettysburg	Pa.	July 1-3, 1863	Meade	Lee	23,000	25,000-28,000	Northern victory marked a turning point in the war.
Kennesaw Mountain	Ga.	June 27, 1864	Sherman	J. Johnston	2,100	400	In spite of Confederate success, Davis replaced Johnston with Hood.
Mobile Bay	Ala.	Aug. 5, 1864	Farragut	Buchanan	320	300	The North closed one of the major Southern ports.
Nashville	Tenn.	Dec. 15-16, 1864	Thomas	Hood	3,100	6,000	Northern victory practically ended Southern resistance in the West.
Perryville	Ky.	Oct. 8, 1862	Buell	Bragg	4,200	3,400	Confederate troops abandoned Kentucky.
Petersburg, Siege of	Va.	June 20, 1864-April 2, 1865	Grant	Lee	42,000	28,000	Months of trench warfare pinned Lee to a defensive.
Seven Days	Va.	June 25-July 1, 1862	McClellan	Lee	15,800	20,100	Richmond was saved from capture, and Northern forces retreated.
Shiloh (Pittsburg Landing)	Tenn.	April 6-7, 1862	Grant	A. Johnston, Beauregard	13,000	10,700	Grant pushed back Southern forces.
Spotsylvania Court House	Va.	May 8-19, 1864	Grant	Lee	17,500	10,000	Grant continued to hammer at Lee's resistant forces.
Stones River (Murfreesboro)	Tenn.	Dec. 31, 1862-Jan. 2, 1863	Rosecrans	Bragg	12,900	11,700	Southern forces failed to follow up an initial victory.
Vicksburg, Siege of	Miss.	May 19-July 4, 1863	Grant	Pemberton	10,000	10,000	Northern victory proved decisive in winning the Mississippi and the West.
Wilderness	Va.	May 5-6, 1864	Grant	Lee	17,700	11,000	Heavy losses failed to halt Grant's progress southward.

*Figures are approximate totals of dead, wounded, missing, and captured.

The war in the East—1861-1863

The Appalachian Mountains divided the Civil War into two main *theaters of operations* (military areas). The Eastern theater stretched east of the mountains to the Atlantic Ocean. The Western theater lay between the mountains and the Mississippi River. A third theater, west of the Mississippi, saw only minor action.

Many Civil War battles have two names because the Confederates named them after the nearest settlement, and Northerners named them after the nearest body of water. In such battles described in this article, the Northern name is given first, followed by the Confederate name in parentheses.

Opening battles

Fort Sumter. The Civil War began on April 12, 1861, when Confederate forces under General Pierre G. T. Beauregard attacked Fort Sumter, a U.S. Army post in the harbor of Charleston, South Carolina. The Union troops surrendered on April 13 and evacuated the fort the next day.

Battles and campaigns of the Civil War

This map locates important battles and campaigns of the Civil War. Most of the fighting in the East occurred in Virginia. Fighting in the West centered in Tennessee and along the Mississippi River. Union strategy succeeded in dividing the Confederacy and blockading its harbors.

WORLD BOOK map



Following the fall of Fort Sumter, a Union army of about 18,000 men under General Robert Patterson held the northern end of the fertile Shenandoah River Valley, which lay in Virginia west of the rival capitals of Washington and Richmond. Another Union force of about 31,000 under General Irvin McDowell moved into eastern Virginia to attack Southern forces. A Confederate army under Beauregard faced McDowell at Manassas, Va., about 25 miles (40 kilometers) southwest of Washington. General Joseph E. Johnston commanded Confederate troops in the Shenandoah Valley. Those forces, along with other scattered troops, added up to about 35,000 Confederates ready for action.

First Battle of Bull Run (or First Battle of Manassas). In July 1861, McDowell approached Manassas, which lay on a creek called Bull Run. McDowell thought his troops could destroy Beauregard's forces while the Union troops in the Shenandoah Valley kept Johnston occupied. But Johnston slipped away and traveled by rail to join Beauregard just before the battle.

The opposing forces, both composed mainly of poorly trained volunteers, clashed on July 21. The North launched several assaults. During one attack, the Confederate General Thomas J. Jackson stood his ground so firmly that he received the nickname "Stonewall." After halting several assaults, Beauregard counterattacked. The tired Union forces fled to Washington, D.C., in wild retreat. After the battle, some Southerners regretted not moving on to capture Washington. But such an attempt would probably have failed.

The North realized that it faced a long fight. The war would not be over in three months, as many Northerners had predicted. Confederate confidence in final victory soared and remained high for the next two years.

The drive to take Richmond

After Bull Run, Lincoln made General George B. McClellan commander of the Army of the Potomac in the East. During the winter of 1861-1862, McClellan assembled a force with which he planned to capture Richmond from the southeast. He wanted to land his men on the peninsula between the York and James rivers and advance along one of the rivers toward the Southern capital. But before McClellan could move, a naval action changed his plans.

First battle between ironclads. In 1861, the Confederates had raised a sunken federal ship, the *Merrimack,* off Norfolk, Va., and covered the wooden vessel with iron plates. The South used the ironclad ship, renamed the *Virginia,* to stage the South's greatest naval challenge to the North. On March 8, 1862, the *Virginia* attacked Northern ships at Hampton Roads, a channel that empties into Chesapeake Bay. It destroyed two Northern vessels and grounded three others. When the ship returned the next day to finish the job, it faced the *Monitor,* an ironclad ship designed especially for the Northern Navy. History's first battle between ironclad warships followed. Although neither ship won, the *Monitor* proved to be the superior vessel. Later, the U.S. Navy built a large ironclad fleet modeled after it.

The peninsular campaign. After the battle of the ironclads, McClellan landed on the peninsula between the York and James rivers with more than 100,000 men. He occupied Yorktown and advanced along the York River. He could not follow the James River because the *Virginia* was on the river. By late May 1862, McClellan was within 6 miles (10 kilometers) of Richmond. Johnston led an attack against McClellan on May 31. But the Confederates failed to follow up their success and were driven back toward Richmond. In the two-day fight, called the Battle of Fair Oaks or Battle of Seven Pines, Johnston was wounded. General Robert E. Lee was given command of Johnston's army, which Lee called the Army of Northern Virginia.

Jackson's valley campaign. The Confederacy feared that McClellan would receive reinforcements from the numerous troops that had stayed behind to protect Washington. Stonewall Jackson therefore launched a campaign in the Shenandoah Valley. He planned to make the Northerners think he was going to attack

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The battle of the ironclads pitted the Northern *Monitor,* against the Southern *Merrimack (Virginia)* in March 1862. Neither ship won, but the event marked the first time that ships were fitted with armor for battle.



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The Battle of Antietam was waged between Confederate forces under General Robert E. Lee and Union forces under General George B. McClellan on Sept. 17, 1862, near the town of Sharpsburg, Md. The savage battle ended with Lee's retreat, giving Lincoln the opportunity to issue the preliminary Emancipation Proclamation on September 22.

Washington. In a series of brilliant moves from May 4 through June 9, 1862, Jackson advanced about 350 miles (560 kilometers) up the Shenandoah Valley and beyond, toward the Potomac River. His 17,000 men received the name "foot cavalry" because they marched so fast. Jackson won four battles against the Union armies. He reached the Potomac but soon had to retreat. However, he had forced the Union to withhold the powerful reinforcements that McClellan had counted on.

Stuart's raid. While Lee planned his strategy as the new commander of the Army of Northern Virginia, Confederate General Jeb Stuart led a remarkable cavalry raid. In June 1862, Stuart and about 1,200 men galloped completely around McClellan's army of 100,000 in three days, losing only one man. Stuart's raid gained information about Union troop movements and boosted Southern morale.

Battles of the Seven Days. Lee planned a daring move to destroy McClellan's army, which lay straddled over the Chickahominy River. With his forces reinforced by Jackson's men to about 95,000 men, Lee fell on McClellan in a series of attacks, called the Battles of the Seven Days, from June 25 through July 1, 1862. The advantage shifted from side to side during the battles, but McClellan believed that his forces were hopelessly outnumbered. He finally retreated to the James River, and Richmond was saved from capture. McClellan's army was ordered to northern Virginia to be united with a force under General John Pope. McClellan was to command the combined army.

The South strikes back

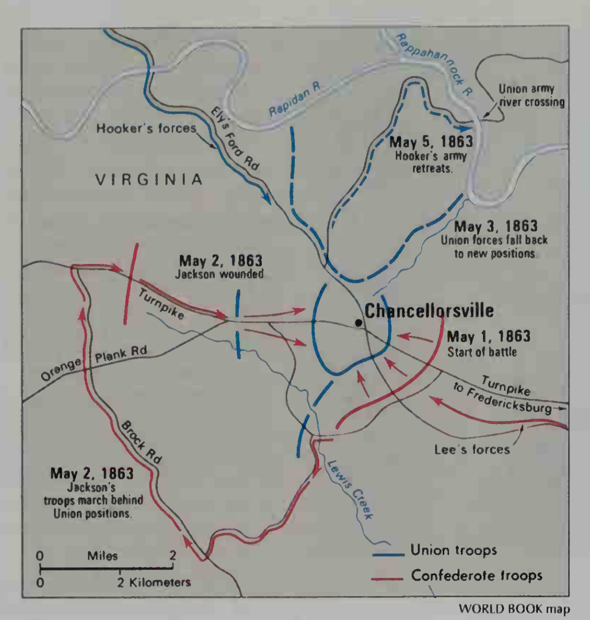
Second Battle of Bull Run (or Second Battle of Manassas). Lee moved rapidly northward to attack Pope, stationed at Manassas, before McClellan's men could join him. Lee sent Jackson ahead to move behind Pope's army and force a battle. On Aug. 29, 1862, Pope attacked Jackson, sending in McClellan's troops as fast as they arrived. Meanwhile, Lee and General James Longstreet had joined Jackson. Pope attacked Lee's army on August 30, but a Confederate counterattack swept the Union forces from the field. The beaten Northern troops plodded back to Washington.

Battle of Antietam (or Battle of Sharpsburg). The South hoped to gain European recognition by winning a victory in Union territory. Lee invaded Maryland in September 1862. He divided his army, sending about half with Jackson to capture Harpers Ferry, Va., which Union troops occupied. McClellan moved to meet Lee with about 90,000 men. On September 13, a Union soldier found a copy of Lee's orders to his commanders wrapped around three cigars at an abandoned Confederate campsite. Lee learned of the loss and took up a position at Sharpsburg, a town on Antietam Creek in Maryland. But McClellan did not immediately attack, giving the Confederate forces time to reunite after Jackson's success at Harpers Ferry. On September 17, McClellan launched a series of attacks that almost cracked the Southern lines. But then, the last of Lee's absent troops, headed by General A. P. Hill, arrived and saved the day. Lee's force of about 40,000 men suffered heavy losses and had to retreat to Virginia.

Antietam was the bloodiest day of the Civil War. About 2,000 Northerners and 2,700 Southerners were killed. Approximately 19,000 men from both sides were wounded, of which about 3,000 later died. Because Lee retreated, the North called Antietam a Union victory. On September 22, Lincoln issued the preliminary Emancipation Proclamation. He had been waiting for a Northern victory as a good time for the proclamation.

Battle of Fredericksburg. As bloody as Antietam was, McClellan had more fresh troops under him after the battle than Lee had left in his entire army. Yet McClellan permitted the Army of Northern Virginia to retreat with almost no interference. Lincoln, who had long felt that McClellan was not aggressive enough, replaced him with General Ambrose E. Burnside as commander of the Army of the Potomac.

Burnside decided to attack Lee at Fredericksburg, Va. The Confederates, about 73,000 strong, established a



The Confederate victory at Chancellorsville was won by Lee with Jackson's help. Lee struck Hooker's Union forces in front, while Jackson attacked the right flank. But Jackson was fatally wounded by accident in the battle.

line of defense along fortified hills called Marye's Heights. On Dec. 13, 1862, Burnside's men tried to storm the hills in a brave but hopeless attack. The Union suffered nearly 13,000 *casualties*—soldiers killed, wounded, missing, or captured—and retreated. Burnside was relieved of command at his own request.

Battle of Chancellorsville. General Joseph Hooker replaced Burnside. In the spring of 1863, the Army of the Potomac numbered about 138,000 men. Lee's forces totaled about 60,000 and still held the line of defense at Fredericksburg. Hooker planned to keep Lee's attention on Fredericksburg while he sent another force around the town to attack the Confederate *flank* (side).

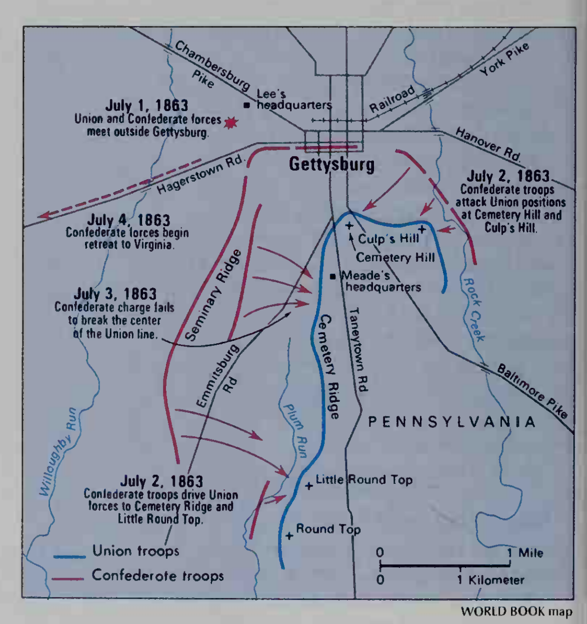
The flanking movement began on April 27, 1863, and seemed about to succeed. But then, Hooker hesitated. On May 1, he withdrew his flanking troops to a defensive position at Chancellorsville, a settlement just west of Fredericksburg. The next day, Lee left a small force at Fredericksburg and boldly moved to attack Hooker. He sent Stonewall Jackson to attack Hooker's right flank, while he struck in front. The attack, on May 2, cut the Northern army almost in two, but Union troops managed to set up a defensive line. Hooker retreated three days later. During the battle, Jackson was shot accidentally by his own men. His left arm had to be amputated. Lee told Jackson's chaplain: "He has lost his left arm; but I have lost my right arm." Jackson died on May 10.

Battle of Gettysburg. In June 1863, Lee's army swung up the Shenandoah Valley into Pennsylvania. The Army of the Potomac followed it northward. Both armies moved toward the little town of Gettysburg. When it appeared that the battle was about to begin, Lincoln put General George G. Meade, a Pennsylvanian, in command of the Union troops. The shooting started when a Confederate brigade, searching for badly needed shoes, ran into Union cavalry near Gettysburg on July 1. For the first three days of July, a Northern army of about 85,000 men fought a Southern army of about 65,000 in the greatest battle ever fought in the Western Hemisphere.

On the first day, the two armies maneuvered for position. By the end of the day, Northern troops had been pushed from west and north of Gettysburg to south of the town. They settled into a strong defensive location that resembled a fishhook. Culp's Hill and Cemetery Hill, at the right, formed the barb of the hook. The front ran about 3 miles (5 kilometers) along Cemetery Ridge and ended at two hills called Little Round Top and Round Top. Confederate forces occupied Gettysburg and then Seminary Ridge, to the west.

On the second day, July 2, Lee tried to crack the Union flanks and roll up Cemetery Ridge. He aimed his main assault at the left flank. Lee managed to crush a Northern corps. Other Union troops, however, held on to Cemetery Ridge and to Little Round Top, perhaps the most important point in the entire Union line. The Confederate attack on the right flank at Culp's Hill and Cemetery Hill came too late to succeed.

On July 3, Lee decided to attack the Union center. After a fierce artillery duel, he ordered General George E. Pickett to prepare about 13,000 men to charge the Union lines. The men, marching in perfect parade formation, swept across an open field and up the slopes of Cemetery Ridge, ignoring enemy fire. Only a few troops reached the top of the ridge, where they were quickly shot or captured. Barely half the soldiers involved in the assault returned to Lee, who took complete responsibility for the attack's failure. Pickett's charge showed the



The Battle of Gettysburg started with Union armies taking up defensive positions south of Gettysburg. Confederate forces attacked both ends of those positions, then failed to break the Union center, turning the battle into a Union victory.

hopelessness of *frontal* (head-on) assaults over open ground against a strong enemy. Lee's attempt to pierce the Union rear with Stuart's cavalry, which had arrived the night before, also failed.

Lee withdrew his battered army to Virginia after the battle. Much to Lincoln's disgust, Meade made little effort to follow him, even though Meade had about 20,000 fresh reserves and had received further reinforcements. Lee's army thus escaped. Gettysburg became a turning point in the war. Casualties among Lee's men numbered between 25,000 and 28,000. Never again would he have the troop strength to launch a major offensive.

The war in the West—1862-1864

In the Western theater, the North attacked early and hard to seize the Mississippi River. Northern forces in the West totaled about 100,000 men, and Southern forces about 70,000. General Henry W. Halleck led Union forces in Arkansas, Illinois, Iowa, western Kentucky, Minnesota, Missouri, and Wisconsin. General Don Carlos Buell led the Northern forces in Indiana, eastern Kentucky, Michigan, and Ohio. General Albert Sidney Johnston led Southern forces in Arkansas, western Mississippi, and Tennessee. His command included General Earl Van Dorn's troops in Arkansas.

Fight for the Mississippi Valley

Battles of Fort Henry and Fort Donelson. The center of the Confederate line in the West rested on two forts about 12 miles (19 kilometers) apart in western Tennessee. They were Fort Henry on the Tennessee River and Fort Donelson on the Cumberland River. If Union forces could capture the forts, the Confederate position in Kentucky and western Tennessee would collapse. Gunboats under orders from General Ulysses S. Grant, commanding officer under Halleck in western Kentucky, took Fort Henry on Feb. 6, 1862. Grant himself moved against Fort Donelson. The Confederate commander, General Simon Bolivar Buckner, asked for "the best terms" of surrender. Grant replied: "No terms except an unconditional and immediate surrender can be accepted." On February 16, about 13,000 of the Confederate troops stationed at Fort Donelson surrendered. Grant gained the nickname "Unconditional Surrender" Grant and became a Northern hero.

Grant's army lay between the two flanks of the Confederate forces. To escape destruction, Johnston pulled his troops back to Corinth, Miss., a major railroad center. The Confederacy had lost Kentucky and half of Tennessee. West of the Mississippi River, a Union army under General Samuel R. Curtis defeated Van Dorn at Pea Ridge, Ark., on March 6 through 8. The defeat put Missouri solidly in Northern hands.

Battle of Shiloh. Halleck, who had become commander of most Union forces from Ohio to Kansas, ordered Grant to move down the Tennessee River and told Buell to join Grant. Grant and some 40,000 men moved to Pittsburg Landing, Tenn., a village about 20 miles (32 kilometers) north of Corinth. Johnston and his co-commander, General Beauregard, decided to strike Grant before Buell arrived. They planned to destroy Grant's forces with their army of some 44,000 troops. The Battle of Shiloh, named after a church on the battlefield, occurred on April 6 and 7, 1862. The battle is also called the Battle of Pittsburg Landing.

On the first day, Confederate troops surprised and almost smashed Grant. But Grant held his lines. Johnston was killed in the battle. The next day, Grant received about 25,000 reinforcements, including some 18,000 troops led by Buell. The Confederate army received only about 700 reinforcements. Grant used his now much larger army to force a Southern retreat to Corinth. The Union suffered about 13,000 casualties, and the Confederacy nearly 11,000. Many Northerners urged Lincoln to replace Grant because of the heavy losses. But Lincoln refused, saying, "I can't spare this man—he fights!"

After Shiloh, Halleck took command of Grant's and Buell's forces. He moved southward and forced Beauregard to evacuate Corinth. By early June, the Union held the Mississippi River as far south as Memphis.

Capture of New Orleans. Meanwhile, Northern forces were moving up the Mississippi River from the South. In April 1862, a naval squadron under Captain David G. Farragut appeared at the mouth of the river. Farragut steamed through the weak Confederate defenses and captured New Orleans on April 25. On May 1, Northerners took control of New Orleans and southern Louisiana, which they held for the rest of the war.

Raids. Some of the most daring actions of the Civil War occurred behind the front lines. In April 1862, a Union spy named James J. Andrews led 21 men through the Confederate lines to Marietta, Ga., where they captured a railroad engine named the *General.* They ran it northward toward Chattanooga, Tenn., destroying telegraph communications as they went. But Confederate troops in another engine, the *Texas,* pursued the *General* and caught it after an exciting chase. The Confederacy hanged Andrews and 7 of his men.

In the spring of 1863, Colonel Benjamin Grierson took a Union cavalry force of about 1,700 men on daring raids between Vicksburg, Miss., and Baton Rouge, La. They tore up about 50 miles (80 kilometers) of railroad track and lured Confederate cavalry and infantry regiments away from Union troops massing near Vicksburg.

Confederate Generals Nathan Bedford Forrest and John Hunt Morgan led many daredevil cavalry raids into enemy territory. In 1864, for example, Forrest's men galloped as far north as Paducah, Ky., destroying Union supplies and communications lines. Morgan led his men, called Morgan's Raiders, on a spectacular dash into Ohio in July 1863. They destroyed property worth about $576,000 before being captured. Morgan escaped in November but was killed a year later in Tennessee.

Battle of Perryville. After Corinth fell to Union forces, Halleck went to Washington to act as Lincoln's military adviser. He assigned Grant to guard communications along the Mississippi and ordered Buell, who had yet to prove himself, to capture Chattanooga. Before

Buell could advance, General Braxton Bragg, the Confederate commander in Tennessee, suddenly invaded Kentucky. Buell raced to meet him, and the two armies clashed on October 8 at Perryville. Neither side won, but Bragg retreated to Murfreesboro, Tenn.

Battle of Stones River (or Battle of Murfreesboro). Lincoln felt that Buell was too cautious and replaced him with General William S. Rosecrans. Rosecrans advanced south from Nashville toward Bragg's army at Murfreesboro on Stones River. The hard-fought battle dragged on from Dec. 31, 1862, to Jan. 2, 1863, when Bragg retreated. The battle had the highest casualty rate of the war, with each side losing about a third of its men.

Siege of Vicksburg. In the winter of 1862-1863, Grant proposed to capture Vicksburg, the key city that guarded the Mississippi River between Memphis and New Orleans. Grant tried several times to take Vicksburg by approaching from the north. But the ground north of the city was low and marshy, and the Union army bogged down. In April 1863, Grant launched a new plan. At night, Union gunboats and supply ships slipped past the Confederate artillery along the river and established a base south of the city. Grant's troops then marched down the west side of the river and crossed over by ship to dry ground on the east side south of the city. In a brilliant campaign, Grant scattered Confederate forces in the field and drove toward Vicksburg. After direct attacks failed, he began a siege of the city in mid-May. Vicksburg finally surrendered on July 4, the day after the Southern defeat at Gettysburg.

Four days later, forces under General Nathaniel P. Banks took Port Hudson, La. The North controlled the Mississippi River, splitting the Confederacy in two.

The Tennessee campaign

Battle of Chickamauga. In September 1863, Rosecrans advanced on Chattanooga with a force of about 55,000 men. Bragg, who was seeking to keep his army free for action, evacuated the city and withdrew to Georgia. Rosecrans recklessly pursued him. Bragg had received reinforcements by rail from Virginia, and his forces numbered approximately 66,000. He fell on Rosecrans savagely at Chickamauga, Ga., on September 19 and 20. The Northern right flank broke completely. Only the Union left flank fought on under General George H. Thomas, who earned the nickname "The Rock of Chickamauga" for holding his line. In the end, Rosecrans' entire army had to retreat to Chattanooga. The Battle of Chickamauga was the Confederacy's last important victory in the Civil War.

Battle of Chattanooga. Bragg did not follow up his victory at Chickamauga immediately. In late September 1863, he finally advanced on Chattanooga. Bragg's army occupied Lookout Mountain, Missionary Ridge, and other heights south of the city. From these points, Confederate artillery commanded the roads and the Tennessee River, by which Chattanooga received its supplies. Starvation threatened Rosecrans' army. But the North had enough troops available in the West to meet any threat. In October 1863, Grant was given command of all Union forces in the West. He replaced Rosecrans with Thomas. Grant then went to Chattanooga with part of his own army.

From November 23 through 25, the Union troops dealt Bragg an immense blow in the Battle of Chattanooga. Lookout Mountain and some other heights fell on the first two days in the so-called Battle Above the Clouds. On November 25, Thomas' army, anxious to make up for its defeat at Chickamauga, swept up Missionary Ridge without orders. The successful charge ended the Battle of Chattanooga in an hour. The Union had won Chattanooga. From that base, Northern armies could move into Georgia and Alabama and split the eastern Confederacy in two.

Behind the lines

Hospitals. During the Civil War, many wounded and sick soldiers were treated in hospitals in Northern and Southern cities. But most received care in temporary facilities. Such facilities included field hospitals on or near battlegrounds, hospital ships and barges, and civilian buildings converted for medical use.

By today's standards, the medical care was primitive during the Civil War. More than twice as many soldiers died of disease—especially of dysentery, malaria, or typhoid—as were killed in battle. Doctors did not yet understand the importance of sanitation, a balanced diet, and sterile medical equipment and facilities. But medical care within the military made some progress with the introduction of horse-drawn ambulances and a trained ambulance corps. The first such corps, begun in 1862, served under Union General McClellan.

Women performed a key role in providing medical care. Mary Walker served as a surgeon with the Union Army. She became the only woman ever to receive the Medal of Honor. Dorothea Dix, famous for her earlier work in mental institutions, was superintendent of U.S.



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Medical care during the Civil War was given in temporary facilities and in city hospitals like this one in Washington, D.C. Temporary facilities included field hospitals on battlegrounds.

Army nurses. Thousands of volunteer nurses served the Union and Confederate forces. One of the North's volunteer nurses, Clara Barton, later founded the American Red Cross.

Private organizations also helped care for ill and wounded soldiers. One organization was the United States Sanitary Commission, created in June 1861. It operated hospitals and distributed food, clothing, medicine, and other supplies. The organization cared for both Union and Confederate soldiers.

Prisons. About 194,000 Union soldiers and about 214,000 Confederate soldiers were held prisoner during the Civil War. The North and the South had about 30 major prison camps each. Both sides also set up temporary prison quarters. Prison conditions were generally miserable because the camps were overcrowded and officials could not provide adequate care. In the South, where such necessities as food and clothing were in short supply for the Confederacy's own soldiers and civilians, prisoners had an especially difficult time.

One of the best-known prisons was Andersonville, a Confederate camp in Georgia. It was horribly overcrowded, and prisoners were deliberately abused and neglected. At Andersonville, as many as 32,000 Northern prisoners at a time were crowded into a log stockade designed to hold 10,000 people. After the war, the graves of nearly 13,000 Union prisoners were discovered there. The officer in charge of Andersonville, Henry Wirz, became the only Confederate soldier to be tried and executed for war crimes after the war.

At first, no official prisoner exchange took place between North and South. The Union government refused to extend such a degree of recognition to the Confederacy. A successful prisoner exchange agreement was reached by the middle of 1862. However, the agreement broke down in 1863, chiefly because the Confederacy resented the Union's use of black soldiers and refused to treat them as prisoners of war. After the Confederate government itself authorized the use of black soldiers in 1865, large-scale prisoner exchange started again.

The final year—1864-1865

All signs pointed to victory for the Union in early 1864. The size of the Southern armies had dwindled because of battle losses, war weariness, and Northern occupation of large areas of the Confederacy. Southern railroads had almost stopped running, and supplies were desperately short. But the South, still capable of tough resistance, fought on for over a year before surrendering.

Grant in command

Since 1862, Lincoln had wanted the Union armies to have a unified command and a coordinated strategy. Lincoln favored a *cordon offense*—a strategy in which the Union armies would advance on all fronts, pitting the vast Northern resources against the South. In Grant, Lincoln felt that he had finally found the leadership needed to carry out such an offensive.

On March 9, 1864, Lincoln promoted Grant to lieutenant general and gave him command of all Northern armies. Grant planned three main offensives. The Army of the Potomac, under Meade, would try to defeat Lee in northern Virginia and occupy Richmond. Grant intended to accompany and direct that army. An army under General William T. Sherman would advance from Chattanooga into Georgia and seize Atlanta. Banks would move his men from New Orleans to Mobile, Ala., and later join Sherman. The third offensive never developed because of a crushing defeat suffered by Banks on April 9 in a battle at Pleasant Hill, La.

Battle of the Wilderness. In May 1864, the Army of the Potomac moved into a desolate area of northern Virginia called the Wilderness. Grant, with about 118,000 men, planned to march through the Wilderness and force the Confederates into a battle that would have a clear winner. Lee, with only about 62,000 troops, met Grant on May 5, and the Battle of the Wilderness raged for two days. Troops stumbled blindly through the forest, where cavalry proved useless and artillery did little good. The underbrush caught fire, and wounded men died screaming in the flames. Both sides suffered heavy losses, and neither could claim it had won.

Battle of Spotsylvania Court House. In spite of his losses, Grant was determined to push on to final victory or defeat. He moved off to his left toward Richmond. Lee marched to meet him, and the great opponents clashed again at Spotsylvania Court House, Va., on May 8 through 19, 1864. Spotsylvania, like the Wilderness, brought large losses but no victory for either side.

Battle of Cold Harbor. Grant again moved off to his left toward Richmond, and again Lee marched to meet him. By June 1, 1864, Grant had reached Cold Harbor, a community just north of the Confederate capital. There, on June 3, he made another attempt to smash Lee. About 50,000 attackers faced 30,000 defenders in trenches across a 3-mile (5-kilometer) line. Northern troops charged in a frontal assault. Murderous gunfire cut down some 7,000 of them, chiefly in the first minutes of the charge. Grant later said, "I regret this assault more than any one I have ever ordered."

Cold Harbor forced Grant to change his strategy. Lee had shown superb defensive skill, and Northern losses had been enormous. In a month of fighting, Grant had lost almost 40,000 men. Newspapers began to call him "butcher Grant." Grant felt that if he repeated his moves, Lee would fall back to the Richmond defenses, where the Confederates could hold out against a siege. Grant therefore made one more attempt to force a quick and final win-or-lose battle.

Siege of Petersburg. Concealing his movement from Lee, Grant marched south and crossed the James River. His soldiers built *pontoon* (floating) bridges across the river. Grant then advanced on Petersburg, a rail center south of Richmond. All railroads supplying Richmond ran through Petersburg. If Grant could seize the railroads, he could force Lee to fight in the open. But a small Confederate force under Beauregard held him off

until Lee arrived. Grant then realized that he could not destroy Lee's army without a siege. His men dug trenches around the city. Lee's weary troops did the same. The deadly siege of Petersburg began on June 20, 1864. It lasted more than nine months, until the Confederate troops withdrew at the war's end.

Cavalry maneuvers. While Grant was moving toward Richmond, he had sent his cavalry ahead under Sheridan to attack the city's communications. Confederate cavalry led by Jeb Stuart opposed Sheridan. The two forces met at Yellow Tavern, Va., on May 11, 1864. Stuart was fatally wounded in the battle.

In June, Lee sent an infantry force under General Jubal A. Early through the Shenandoah Valley to raid Washington, D.C. He hoped that Grant would send some of his troops to guard the Northern capital. Early attacked one of the forts on the outskirts of the city. Lincoln stood on a low wall atop the fort and watched the attack as bullets spattered around him. Early was not strong enough to take the capital and retreated to Virginia. But he remained a threat in the valley.

Although the Confederates could not take Washington, their ability to threaten the capital after three years of war weakened Northern morale. Grant thus put all Union forces in the Shenandoah Valley under Sheridan and ordered him to follow Early to the death. Sheridan's forces outnumbered the Confederates 2 to 1 and drove them from the valley in a series of victories. His greatest success came at Cedar Creek, Va., on Oct. 19, 1864, when Early made a surprise attack while Sheridan was returning from a conference in Washington. Riding to the field from nearby Winchester, Sheridan rallied his men and won the battle. Sheridan then laid waste to the valley to flush out ambushers and to prevent its resources from being used by any Confederate army that might try again to attack Washington.

Battle of Mobile Bay. The North's blockade of Southern ports grew more effective. Union forces worked steadily to seize the main ports still open to ships that slipped through the blockade. In August 1864, a naval squadron under Farragut sailed into the bay at Mobile, Ala., which was defended by forts; mines (then called *torpedoes*); gunboats; and an ironclad. After the Union lead ship, an ironclad, was blown up, Farragut ordered his own wooden commander's ship, the *Hartford,* into the lead. "Damn the torpedoes! Full speed ahead!" was the cry he reportedly bellowed. The Union sailors captured the forts and took control of the bay, though they did not occupy Mobile. In February 1865, another main port, Wilmington, N.C., fell to Northern ships. But Charleston, S.C., still held out.

Closing in

The Atlanta campaign. In May 1864, while Grant drove into the Wilderness, Sherman's army of about 100,000 men advanced on Atlanta, Ga., from Chattanooga. General Joseph E. Johnston opposed him with a force of about 62,000. Johnston planned to delay Sherman and draw him away from his base. The Atlanta campaign developed into a gigantic chess game. Sherman repeatedly moved forward, trying to trap Johnston into battling on open ground. Each time, Johnston and his troops slipped away into prepared trench positions. The two armies clashed frequently in small battles. The largest battle occurred on June 27 at Kennesaw Mountain, an isolated peak near Atlanta.

As Sherman reached the outskirts of Atlanta, President Davis, perhaps more for political than military reasons, decided Johnston fought too cautiously. He replaced him with General John B. Hood. Hood attacked the Union columns as Sherman approached Atlanta. But Hood's attacks failed, and he took up a position in the city. Sherman first tried siege operations. But because he did not want to be delayed, he wheeled part of his army south of Atlanta and seized its only railroad to cut Hood's supply line. Hood evacuated the city on Sept. 1, 1864. Sherman occupied it the next day.

North to Nashville. Sherman's victory was not as complete as it seemed. Hood's army had escaped and begun hit-and-run raids on Sherman's railroad commu-

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Sherman's march through Georgia was aimed at destroying any civilian and industrial property that might help the South continue fighting. His troops tore up railroad tracks and burned property as they swept across the state on a path 50 miles (80 kilometers) wide. Atlanta was left in flames, *above.*

nications with Chattanooga. Sherman thought it would be useless to chase Hood along the railroad. Instead, he sent Thomas back to Tennessee to take command and gave him some 32,000 men under General John M. Schofield. He ordered Thomas, at Nashville, to assemble more troops in Tennessee and keep Hood out of the state. With his remaining men, Sherman planned to cross Georgia to Savannah, near the Atlantic coast.

Hood boldly decided to invade Tennessee in the hope that Sherman would follow him. He felt sure that he could beat Sherman in the mountains. He would then either invade Kentucky or cross into Virginia and join Lee. But Hood's plan was too big for his army.

Battle of Franklin. Hood might have won a partial success if he had moved into Tennessee immediately. But he delayed and met Schofield's force at Franklin, Tenn., on Nov. 30, 1864. Hood, an aggressive commander, had complained that his army had retreated so much under Johnston that it had forgotten how to attack. His generals seemed determined to prove him wrong. In six reckless charges, the Confederates suffered about 6,300 casualties, including 6 generals killed.

Battle of Nashville. Hood had no chance of success after his defeat at Franklin. He took a position south of Nashville and waited. In the city, Thomas had time to gather an army of about 55,000. He attacked Hood on Dec. 15 and 16, 1864, and won one of the biggest victories of the war. The Confederates beat a bitter retreat to Mississippi.

Sherman's march through Georgia began on Nov. 15, 1864, when he left Atlanta in flames. His army, numbering about 62,000 men, swept almost unopposed on a 50-mile (80-kilometer) front across the state. Advance troops scouted an area. The men who followed stripped houses, barns, and fields and destroyed everything they could not use. Sherman hoped the horrible destruction would break the South's will to continue the war.

Sherman occupied Savannah on December 21 and sent a message to Lincoln: "I beg to present to you as a Christmas gift the city of Savannah with 150 heavy guns and plenty of ammunition and also about 25,000 bales of cotton." From Savannah, Sherman swung north into South Carolina. There, on the breeding ground of the Southern independence movement, his army seemed bent on revenge. They burned and looted on a scale even worse than in Georgia. When Charleston surrendered, it was spared. Although Sherman tried to prevent it, most of Columbia, the state capital, was burned.

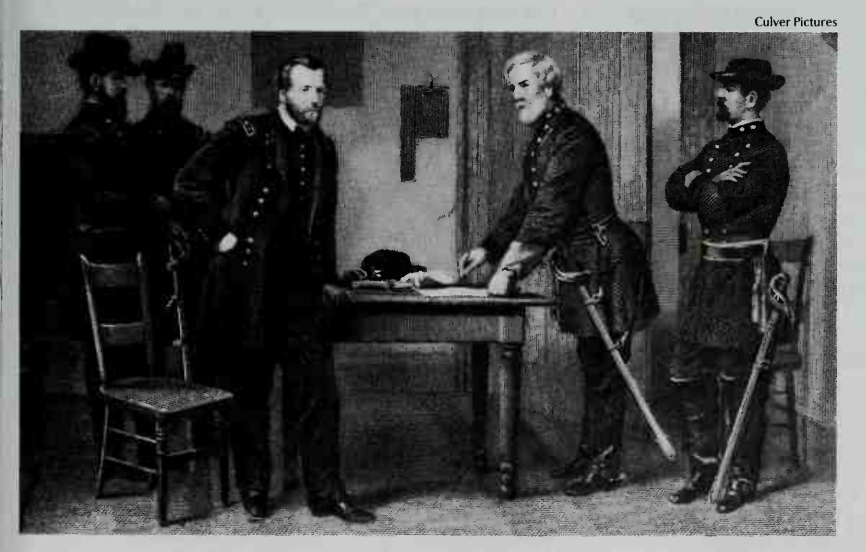
Sherman and his troops then moved on into North Carolina. Johnston tried to oppose them, but he had only one-third as many men. The Northerners drove on toward Virginia to link up with Grant.

The South surrenders. In Virginia, Grant at last achieved his goal. In April 1865, he seized the railroads supplying Richmond. The Confederate troops had to evacuate Petersburg and Richmond. Lee retreated westward with nearly 50,000 men. He hoped to join forces with Johnston in North Carolina. But Grant overtook him and barred his way with an army of almost 113,000 troops. Lee realized that continued fighting would mean useless loss of lives. He wrote Grant and asked for an interview to arrange surrender terms.

On April 9, 1865, the two great generals met in a house owned by a Southern farmer named Wilmer McLean in the little country settlement of Appomattox Court House, Va. The meeting was one of the most dramatic scenes in American history. Grant wore a mud-spattered private's coat, with only his shoulder straps indicating his rank. Lee had put on a spotless uniform, complete with sword. Grant offered generous terms, and Lee accepted them with deep appreciation. The Confederate soldiers received a day's rations and were released on parole. They were allowed to keep their horses and mules to take home "to put in a crop." Officers could keep their side arms.

Five days later, on April 14, Lincoln was assassinated. Northerners cried out for revenge for Lincoln's death and for the hundreds of thousands killed in the war. But before his death, Lincoln had advised "malice toward none . . . charity for all" to heal the country's wounds.

Culver Pictures



Lee surrendered to Grant, *left,* at a house in Appomattox Court House, Va., on April 9, 1865. With Lee's surrender of the main Confederate army, the Civil War soon ended.

Although feelings were strong, no major incidents occurred.

With Lee's army gone, Johnston surrendered to Sherman on April 26 near Durham, N.C. Confederate President Davis fled southward and was captured in Georgia. General Richard Taylor surrendered the Confederate forces in Alabama and Mississippi on May 4. On May 26, General Edmund Kirby Smith surrendered the last Confederate army still in the field. The war to preserve the American Union was over.

Results of the war

The tragic costs. About 620,000 soldiers died during the Civil War, almost as many as the combined American dead of all other wars from the Revolutionary War (1775-1783) through the Vietnam War (1957-1975). The Union lost about 360,000 troops, and the Confederacy about 260,000. More than half the deaths were caused by disease. About a third of all Southern soldiers died in the war, compared with about a sixth of all Northern soldiers.

Both the North and the South paid an enormous economic price as well. But the direct damages caused by the war were especially severe in the South. The destruction in the South extended from the beautiful Shenandoah Valley in the north to Georgia in the south and from South Carolina in the east to Tennessee in the west. Towns and farms, industry and trade, and the lives of men, women, and children were ruined throughout the South. The whole Southern way of life was lost.

Terrible bitterness between the people of the North and South followed the Civil War and continued for generations. The South was given almost no voice in the social, political, and cultural affairs of the nation. With the loss of Southern control of the national government, the more traditional Southern ideals no longer had an important influence over government policy. The Yankee Protestant ideals of the North became the standard for the United States. However, those ideals, which stressed hard work, education, and economic freedom, helped encourage the development of the United States as a modern, industrial power.

The beginning of modern warfare. The Civil War changed the ways of waging war. It has been called the first modern war. The conflict introduced tactics and weapons that, in improved forms, were used widely during wars of the late 1800's and 1900's. Civil War soldiers were the first men to fight under a unified command, to battle from trenches, and to wage a major cordon offense. They also were the first soldiers to use *repeating arms,* which could fire several shots without reloading, and *breechloading arms,* which were loaded from behind the barrel instead of at the muzzle. The Civil War introduced observation balloons, ironclad ships, mines, and submarines. Railroads and telegraphy were used for the first time in warfare.

The Civil War is also considered a modern war because of the vast destruction it caused. It was a *total war,* in which all the resources of the opposing sides were used. The Civil War could perhaps have ended only in the complete defeat and unconditional surrender of one side or the other.

The end of slavery. The Declaration of Independence, which gave birth to the United States in 1776, stated that "all men are created equal." Yet the United States continued to be the largest slaveholding nation in the world until the Civil War. Americans tried to make equality a reality soon after the war by *ratifying* (approving) the 13th Amendment to the Constitution, which officially abolished slavery throughout the United States. The place of blacks in American society, however, remained unsettled.

The preservation of the Union. In a fundamental sense, the Civil War may have been the greatest failure of American democracy. The war, in Lincoln's words, was an "appeal from the ballot to the bullet." From 1861 to 1865 in the United States, the calm reason that is basic to democracy gave way to human passions.

Yet democracy in the United States survived its "fiery trial." The nation's motto was *E Pluribus Unum,* a Latin term meaning *out of many, one.* It referred to the creation of one nation, the United States, out of 13 colonies. But for a long time, Americans could not decide whether they wanted to be "many" or "one." The Northern victory established that no state had the right or power to end the Union. Furthermore, the outcome of the war paved the way for the rise of the United States as a major global power.

Gabor S. Boritt

Study aids

Related articles in ***World Book.*** See the *Places to visit* and *History* sections of the articles on those states that fought in the Civil War, such as **Virginia** (Places to visit; History). See also the following articles:

Northern military leaders

Burnside, Ambrose E.
Butler, Benjamin F.
Doubleday, Abner
Farragut, David G.
Foote, Andrew H.
Frémont, John C.
Grant, Ulysses S.
Halleck, Henry W.
Hancock, Winfield S.
Hooker, Joseph
Kearny, Philip
Logan, John A.
McClellan, George B.
Meade, George G.
Miles, Nelson A.
Porter, David Dixon
Porter, Fitz-John
Rosecrans, William S.
Sheridan, Philip H.
Sherman, William T.
Shields, James
Wallace, Lew
Wilkes, Charles

Southern military leaders

Beauregard, Pierre G. T.
Bragg, Braxton
Breckinridge, John C.
Buckner, Simon Bolivar
Early, Jubal A.
Ewell, Richard S.
Forrest, Nathan B.
Hampton, Wade
Hood, John B.
Jackson, Stonewall
Johnston, Albert S.
Johnston, Joseph E.
Lee, Robert E.
Longstreet, James
Morgan, John H.
Mosby, John S.
Pickett, George E.
Polk, Leonidas

Semmes, Raphael
Smith, Edmund Kirby
Stuart, Jeb
Watie, Stand
Wheeler, Joseph

Other biographies

Barton, Clara
Beecher, Henry Ward
Benjamin, Judah P.
Bickerdyke, Mary A. B.
Boyd, Belle
Brady, Mathew B.
Brown, John
Buchanan, James
Chase, Salmon P.
Crane, Stephen
Davis, Jefferson
Dickinson, Anna E.
Douglas, Stephen A.
Edmonds, Sarah E. E.
King, Thomas Starr
Lincoln, Abraham
Mallory, Stephen R.
Mason, James M.
Ruffin, Edmund
Seddon, James A.
Seward, William H.
Slidell, John
Smalls, Robert
Stanton, Edwin M.
Stephens, Alexander H.
Stowe, Harriet Beecher
Walker, Leroy P.
Walker, Mary E.
Welles, Gideon
Whitman, Walt

Causes and background

Abolition movement
African Americans (The years of slavery)
Compromise of 1850
Crittenden Compromise
Dred Scott Decision
Fugitive slave laws
Kansas-Nebraska Act
Missouri Compromise
Nullification
Popular sovereignty
Proslavery movement
Slavery
States' rights
Uncle Tom's Cabin
Underground railroad
Wilmot Proviso

Events

Alabama (ship)
Emancipation Proclamation
Fort Sumter
Gettysburg, Battle of
Gettysburg Address
Hampton Roads Conference
Harpers Ferry
Monitor and Merrimack
Trent Affair

Other related articles

Appomattox Court House
Balloon (Balloons in war)
Confederate States of America
Copperheads
Dixie (song)
Flag (Changes in the United States flag; pictures)
Frietchie, Barbara
Grand Army of the Republic
National Park System
Reconstruction
Sons of Liberty
United States, History of the (The irrepressible conflict)

Outline

I. Causes and background of the war
A. The sectional division
B. The conflict over slavery
C. Developments in the political party system
D. Secession

II. Mobilizing for war
A. How the states lined up
B. Building the armed forces

III. Blacks and the war
A. Early black participation
B. The Emancipation Proclamation
C. The use of black troops
D. Reaction in the South

IV. The home front
A. In the North
B. In the South

V. The war in the East—1861-1863
A. Opening battles
B. The drive to take Richmond
C. The South strikes back

VI. The war in the West—1862-1864
A. Fight for the Mississippi Valley
B. The Tennessee campaign

VII. Behind the lines
A. Hospitals
B. Prisons

VIII. The final year—1864-1865
A. Grant in command
B. Closing in

IX. Results of the war
A. The tragic costs
B. The beginning of modern warfare
C. The end of slavery
D. The preservation of the Union

Questions

Why has the Civil War been called the first modern war?
How did economic conditions in the North and South differ during the Civil War?
Why was the Battle of Gettysburg a turning point in the war?
How did Northerners resist the fugitive slave law?
What were some ways black soldiers were discriminated against during the Civil War?
Why was the outcome of the Battle of Antietam important to Abraham Lincoln?
What are some examples of the sectional division between North and South before the Civil War?
What two victories did the North win within a day of each other?
Why do many of the battles fought during the Civil War have two names?
All explanations for the causes of the Civil War have always involved or revolved around what issue?

Additional resources

Level I
Clinton, Catherine. *Scholastic Encyclopedia of the Civil War.* Scholastic, 1999.
Collier, Christopher and James L. *The Civil War, 1860-1865.* Benchmark Bks., 1999.
Haskins, James. *Black, Blue & Gray: African Americans in the Civil War.* Simon & Schuster, 1998.
Naden, Corinne J., and Blue, Rose. *Why Fight? The Causes of the American Civil War.* Raintree Steck-Vaughn, 1999.
Zeinert, Karen. *Those Courageous Women of the Civil War.* Millbrook, 1998.

Level II
Catton, Bruce. *The American Heritage New History of the Civil War.* Viking, 1996.
McPherson, James M. *Battle Cry of Freedom.* Oxford, 1988. *For Cause and Comrades: Why Men Fought in the Civil War.* 1997.
Stokesbury, James L. *A Short History of the Civil War.* 1995. Reprint. Morrow, 1997.
Trudeau, Noah A. *Like Men of War: Black Troops in the Civil War, 1862-1865.* Little, Brown, 1998.
Wooster, Robert. *The Civil War 100.* Carol Pub. Group, 1998. Biographies of 100 Civil War participants.

Civilian Conservation Corps (CCC) was an agency authorized by the government to hire unemployed young men for public conservation work. The corps was set up as part of the New Deal program in 1933. It provided training and employment. The CCC conserved and developed natural resources by such activities as planting trees, building dams, and fighting forest fires. More than 2 million men served in the corps before Congress abolished it in 1942. See also **Conservation** (The rise of the conservation movement; picture).

James T. Patterson

Civilization is a way of life that arose after people began to live in cities or in societies organized as states. The word comes from the Latin word *civis,* which means *citizen of a city.*

A civilization consists of the art, customs, technology, form of government, and everything else that makes up the way of life in a society. In this respect, civilization is similar to culture. But culture refers to any way of life and includes both simple and complex lifestyles. The word *civilization* refers only to lifestyles that feature complex economic, governmental, and social systems.

Therefore, every human being lives within a culture, but not everyone lives within a civilization. See **Culture**.

Throughout history, individual civilizations have arisen and collapsed, but the basic features of civilization do not disappear. Ideas and inventions spread from one civilization to another. In many cases, similar developments occur independently in different civilizations.

How civilizations develop. During most of the prehistoric period, people lived in small groups and moved from place to place in search of food. They hunted, fished, and gathered wild plants. These early people had a simple social organization based on close family ties. Between 13,000 and 10,000 years ago, some societies of hunters and gatherers in the Middle East adopted more settled ways of life and developed social organizations based on larger, more formal groups. All of these societies developed in areas with predictable seasonal supplies of such foods as fish and easily gathered plant foods. Some archaeologists believe that the social changes occurred in part because certain grain plants became more plentiful near the end of the last ice age, about 10,000 years ago. The technology and social organizations of some of these more advanced societies served as a foundation for later farming societies.

About 9000 B.C., people in the Middle East began to cultivate cereal grasses and other plants. They also domesticated goats and sheep at about this time, and they later tamed cattle. In Southeast Asia, people had begun raising crops by about 7000 B.C. People in what is now Mexico also learned to grow crops by about 7000 B.C.

The rise of agriculture was a major step in the development of civilization. Farmers settled in permanent villages, which had enough food to support a few craftworkers and priests. Periodic food shortages led to increased trade among villages. The villagers exchanged grain, pottery, and various raw materials.

By about 3500 B.C., people in the Middle East had learned to smelt copper and make bronze tools and weapons. The demand for metal ore increased, and priests and chieftains gained greater control over trade. Gradually, villages in the Middle East grew into cities. Religious shrines and sacred places, which flourished as ceremonial sites, became the centers of economic and political power in the emerging cities.

Several civilizations developed independently in various parts of the world. The first one arose about 3500 B.C. in the Tigris-Euphrates Valley in the Middle East. Other civilizations developed in the Nile Valley in Egypt, the Indus Valley in what are now Pakistan and northwestern India, the Huang He Valley in China, and the Andes Mountains of present-day Peru. These ancient civilizations grew up in widely different natural environments. The people developed systems of writing and new forms of government, made advances in science and technology, and excelled in crafts and art. For a description of these and other early civilizations, see **World, History of the**.

Why civilizations rise and fall. Philosophers, historians, and archaeologists have suggested many reasons for the rise and fall of civilizations. Georg W. F. Hegel, a German philosopher of the early 1800's, compared societies to individuals who pass the torch of civilization from one to another. During this process, according to Hegel, civilization develops through three stages: (1) rule by one person, a dictator; (2) rule by one class of society; and (3) rule by all the people. Hegel believed the process eventually results in freedom for all people.

The German philosopher Oswald Spengler thought civilizations, like living things, are born, mature, and die. In *The Decline of the West* (1918-1922), he wrote that Western civilization is dying and will be replaced by a new Asian civilization.

The British historian Arnold Toynbee proposed his theory of *challenge and response* in *A Study of History* (1934-1961). Toynbee believed that civilizations arise only where the environment challenges the people, and only when the people are ready to respond to the challenge. For example, a hot, dry climate makes land unsuitable for farming and represents a challenge to people who live there. The people may respond to this challenge by building irrigation systems to improve the land. Toynbee suggested that civilizations collapse when the people lose their creativity.

Most archaeologists attribute the rise of civilizations to a combination of causes, including the structure of political and social life, the ways people modify their environment, and changes in population. In many cases, civilizations may have appeared because local chieftains took deliberate steps to strengthen their own political power. Many scientists believe that political forces and the misuse of land and other natural resources resulted in the economic and political collapse of early civilizations. Brian M. Fagan

For a discussion of the history of civilization, see **World, History of the**. See also **City**.

Civitan International, *SIHV ih tan,* is an association of service clubs dedicated to good citizenship. The clubs strive to provide their members with fellowship and increased knowledge and to render service to the community and nation. Civitan projects include aid to developmentally disabled persons, civic improvement programs, scholarship programs, and sponsorship of awards for citizenship and service.

About 38,000 men and women belong to the approximately 1,200 Civitan clubs. There are clubs in the United States, Canada, Mexico, South Korea, Japan, Norway, Sweden, Germany, and Austria. The organization was chartered in 1920. The mailing address is P.O. Box 130744, Birmingham, AL 35213.

Critically reviewed by Civitan International

CLA. See **Canadian Library Association; Catholic Library Association.**

Claiborne's Rebellion, *KLAY bohrnz,* was a series of conflicts in the 1630's and 1640's in which William Claiborne, a Virginia fur trader, refused to accept the authority of Leonard Calvert, the governor of Maryland. Claiborne came to Virginia from England in 1621. He explored Chesapeake Bay and became interested in the Indian fur trade. Claiborne went to England and obtained a trading license in 1631. When he returned to the bay area, he set up a trading post on Kent Island in the bay.

According to a charter issued to the Calvert family in 1632, Kent Island lay within the boundaries of Maryland. Claiborne refused to acknowledge the authority of the Calverts, and war broke out. Claiborne was forced to leave the island. However, in 1644, with some Puritan settlers, he drove Calvert out and seized control of the colony. Oliver Cromwell ordered the restoration of the

Calvert government in 1657, and Claiborne returned to Virginia. Claiborne played a prominent role in the affairs of the Virginia colony until he died in 1677.

Marshall Smelser

See also **Maryland** (Colonial days).

Clair, René, *ruh NAY* (1898-1981), was a French motion-picture director. He gained his first acclaim with the silent comedy *An Italian Straw Hat* (1927). He won praise for his creative use of sound in the early sound films *Under the Roofs of Paris* (1929), *A Nous la Liberté* (*Give Us Liberty,* 1931), and *Le Million* (1931).

Clair was born in Paris. His real name was René-Lucien Chomette. During World War II (1939-1945), he worked in the United States and directed the comedy fantasies *I Married a Witch* (1942) and *It Happened Tomorrow* (1944). He returned to France in 1946. In 1960, Clair became the first moviemaker to be elected to the French Academy. Gene D. Phillips

Clairvoyance, *klair VOY uhns,* is an awareness of events, objects, or people without the use of the senses of hearing, sight, smell, taste, or touch. It is a major form of *extrasensory perception* (*ESP*). A person who can locate a lost child or perform similar acts without using known senses might be considered clairvoyant.

Clairvoyance supposedly is not affected by time or distance. A person may "see" an accident in a dream before it happens or sense an event taking place far away. Awareness of an event before it occurs is known as *precognitive clairvoyance.* Clairvoyance is under scientific investigation, and the question of its existence remains open. However, most scientists are skeptical. The relationship of clairvoyance to telepathy, if any, is not known. James E. Alcock

See also **Extrasensory perception; Telepathy; Mind reading; Parapsychology; Psychical research.**

Clam is an animal whose soft body is covered with a protective shell. Clams live on the bottoms or along the shores of oceans, lakes, and streams in many parts of the world. Clams are a type of *mollusk,* a group of soft-bodied animals that have no bones (see **Mollusk** [Bivalves]).

The body of a clam. Clams use a large, muscular organ called a *foot* to burrow in mud or sand. The clam's shell is made up of two parts called *valves.* A *ligament* connects the valves. *Adductor muscles* cause the valves to open and close.

The *mantle,* a thin, fleshy part of the body just inside the shell, produces substances that form the shell. Clam shells are composed chiefly of *calcium carbonate,* a major component in limestone. In many shells, a smooth, shiny substance called *mother-of-pearl* or *nacre* forms an inner layer.

The space between the main body of the clam and the mantle is called the *mantle cavity.* Clams have gills that hang into the mantle cavity. In most clams, water filled with food and oxygen passes into the mantle cavity through two openings called *siphons.* Water enters through the *incurrent siphon,* passes through the gills, and exits through the *excurrent siphon.*

Small hairs called *cilia* cover the gills. Food particles are usually trapped on the gills and are carried by the cilia to a small mouth. The mouth leads to the stomach, where food is partly digested. The clam completes digestion in *digestive glands,* which hang off the stomach.

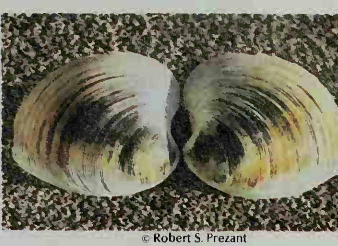
Some kinds of clams

Clams live on the bottoms of oceans and other bodies of water in many areas of the world. Their shells vary greatly in size and shape. Four important kinds of clams are shown below.



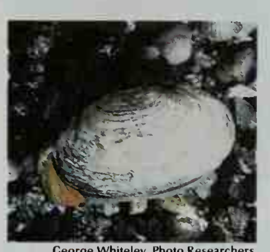
© Robert S. Prezant

Asian clams



© Robert S. Prezant

Hard-shell clams



George Whiteley, Photo Researchers

Soft-shell clam



Kjell B. Sandved

Giant clam

Waste travels out through the clam's intestine. Clams have a heart, blood vessels, and kidneys.

The life of a clam. Most clams feed on tiny water organisms called *plankton.* Some clams obtain food from the mud or sand in which they live. Other clams feed on small, shrimplike animals.

Clams reproduce sexually. In most species, each clam is either male or female. Males release sperm, and females release eggs. The sperm unite with and fertilize the eggs in the surrounding water or in the gills of the female. Fertilized eggs of most clams develop into tiny, swimming larvae called *veligers.* Veligers eventually become mature clams. In some species of clams, the same individual produces both sperm and eggs.

Types of clams. Several types of clams are valuable as food. These types include such saltwater species as the *hard-shell clam* and the *soft-shell clam.* Hard-shell clams are harvested along the Atlantic coasts of Canada and the United States. Soft-shell clams have a smooth, thin shell. They are found on tidal flats from South Carolina to Greenland. Soft-shell clams from the mudflats of New England are especially popular.

The *giant clam,* another major type of saltwater clam, lives on coral reefs in the Red Sea, the Indian Ocean, and the western Pacific Ocean. These clams can grow to a length of more than 4 feet (1.2 meters). Many people have collected giant clams for their shells, greatly reducing the population of these animals.

The *Asian clam* is an abundant type of freshwater clam. It was brought to North America from China in the 1930's. Today, many Asian clams live in cooling systems of power plants. Sometimes there are so many that they slow the necessary waterflow and cause severe damage.

Scientific classification. Clams belong to the phylum Mollusca. They are members of the class Bivalvia. Hard-shell clams

are in the family Veneridae, soft-shell clams are in the family Myidae, giant clams are in the family Tridacnidae, and Asian clams are in the family Corbiculidae. Robert S. Prezant

See also **Aquaculture**; **Biology** (picture); **Cockle**; **Geoduck** (picture); **Shell** (picture).

Clan is a group of people who are related through a common ancestor. Some clans are *matrilineal* (related through the female line). Others are *patrilineal* (related through the male line). Although they may live far apart, members of a clan feel a close relationship to each other and usually have a strong spirit of unity. They often share property or special privileges. Most clans are *exogamous.* That is, the members must marry outside of the clan. Clans are often named after a *totem* (a symbolic animal or plant). American Indian tribes had clans such as the Bear clan or Tobacco clan.

The word *clan* also refers to groups of people in early Scotland and Ireland who had common ancestors and a common name, and were organized under the rule of a chief. These clans were *bilateral* (related through both men and women), and marriage within the clan was customary. The Scottish clans began about A.D. 1000. They carried on feuds in the Highlands, and clan members were expected to defend one another. Most clans lost power after the rebellion of 1745, but a spirit of clan loyalty remains among Scots. They are distinguished by their names—such as MacDonald and Campbell—and by their *tartans,* the plaids worn as emblems of clan membership (see **Tartan**). Jennie Keith

Clarendon, Earl of (1609-1674), played a leading part in restoring the monarchy in England in 1660. Clarendon originally sided with Parliament in its dispute with King Charles I, who tried to keep all political power for himself. But when civil war broke out in 1642, Clarendon joined the *Royalists* (supporters of the king). He insisted that the king represented the entire kingdom, not just a royal group. Named lord chancellor in 1660, he tried to restore England to, in his words, "its old good manners, its old good humor, and its old good nature." But he was forced into exile in 1667. In exile he wrote the 10-volume *History of the Rebellion,* which defends the Royalist activities during the civil war. Clarendon was born Edward Hyde in Dinton, England. He studied at Oxford University. Lacey Baldwin Smith

Clarinet is a woodwind instrument. Most clarinets are made of wood. The instrument consists of a tube with a mouthpiece at one end and a bell-shaped opening at the other end. A clarinet has open *tone holes* and other holes covered by small metal levers called *keys.* The musician places his or her fingertips on the holes and keys and blows on a flat cane reed attached to the mouthpiece. The reed vibrates, producing a full, rich tone. The musician plays different notes by covering or uncovering various holes. Clarinets are manufactured in five pitches. The B-flat soprano clarinet is the most popular.

Johann Christoph Denner, a German instrument maker, invented the clarinet about 1700. It has been an important instrument in bands and orchestras since the mid-1700's. Thomas C. Slattery

See also **Music** (pictures: Wind instruments).

Clark is the family name of two Americans—father and son—who held important government positions.

Tom Campbell Clark (1899-1977), the father, served as an associate justice of the Supreme Court of the United States from 1949 to 1967. He generally voted with the conservative group on the court, though he regularly supported the government in antitrust cases. He also took an active part in movements to improve the U.S. judicial system.

Clark was born in Dallas, Tex. He received A.B. and LL.B. degrees from the University of Texas. He joined the Department of Justice in 1937, and became assistant attorney general of the United States in 1943. President Harry S. Truman appointed Clark attorney general in 1945. He served in that position until 1949, when Truman named him to the Supreme Court.

Ramsey Clark (1927-), the son, was attorney general of the United States from 1967 to 1969, under President Lyndon B. Johnson. Clark had been assistant attorney general from 1961 to 1965 and deputy attorney general from 1965 to 1967. In 1974, he ran as the Democratic nominee for U.S. senator from New York, but lost. He then practiced law in New York.

Throughout his career, Clark has been identified with liberal causes. As attorney general, he supported civil rights initiatives and favored reform of criminal procedure. In private practice, Clark attacked the death penalty and represented many individuals involved in protest activity.

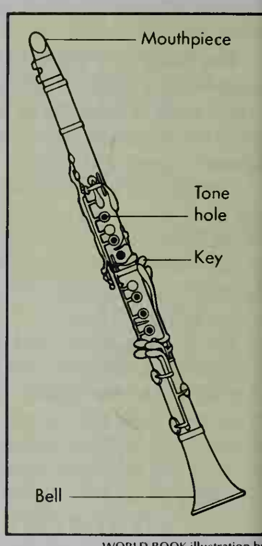
William Ramsey Clark was born in Dallas, Tex. He received a B.A. degree from the University of Texas, and A.M. and J.D. degrees from the University of Chicago. He wrote *Crime in America* (1970). Owen M. Fiss

Clark, Abraham (1726-1794), was an American political leader during the Revolutionary War in America (1775-1783) and a New Jersey signer of the Declaration of Independence. He served in the Second Continental Congress, the Congress of the Confederation, and the U.S. Congress.

Clark was born in Elizabethtown, N.J. He was called the *Poor Man's Counselor* because he defended poor farmers in land cases. Clarence L. Ver Steeg



David R. Frazier



WORLD BOOK illustration by Oxford Illustrators Limited

The clarinet is a popular woodwind instrument. A musician blows through the mouthpiece and produces different notes by pressing keys and covering or uncovering tone holes.

Clark, Charles Joseph. See Clark, Joe.

Clark, George Rogers (1752-1818), was an American frontiersman and soldier who won important victories in the Northwest Territory during the Revolutionary War in America (1775-1783). The Northwest Territory was a vast tract of land lying north of the Ohio River, south of Canada, west of Pennsylvania, and east of the Mississippi River. Clark's victories helped the American negotiators claim this area during peace talks with Britain that ended the Revolutionary War.

Clark was born near Charlottesville, Virginia. He became a surveyor as a young man and began exploring and surveying the western frontier. When the Revolutionary War broke out in 1775, Clark was living in Kentucky. Although this region was claimed by the Colony of Virginia, the Virginia colonial government at first refused to send military aid to protect the Kentucky settlers from raids by the Indian allies of the British. In response, Clark argued, "If a country is not worth protecting, it is not worth claiming." Then Virginia officials sent gunpowder to the settlers.

In 1777, Clark convinced Governor Patrick Henry of Virginia that the British were supplying weapons to the Indians to fight the Kentuckians. Britain sought to control all the region west of the Appalachian Mountains. Clark was commissioned a lieutenant colonel in the Virginia militia and pulled together about 175 men to carry the fight into the Northwest Territory. In 1778 and 1779, he and his men captured Kaskaskia, Cahokia, and Vincennes, three key settlements in what are now southern parts of Illinois and Indiana. In 1783, Britain formally surrendered the region to the United States. See **Northwest Territory**.

In 1783, Thomas Jefferson, who was then serving as a member of Congress, asked Clark to explore the land west of the Mississippi River. However, Clark refused. His younger brother, William, agreed to take part in a similar project in 1803 and became a leader of the Lewis and Clark expedition (see **Clark, William**).

James Kirby Martin

Clark, Helen Elizabeth (1950-), became prime minister of New Zealand in 1999. She succeeded Jenny Shipley. Shipley was New Zealand's first female prime minister, but Clark was the first woman to gain the office by leading her party to victory in a general election. Shipley had become prime minister in 1997 after replacing Jim Bolger as leader of the National Party. Following elections held in November 1999, the Clark-led Labour Party formed a government with the Alliance Party. Clark is known for her work on behalf of international peace and disarmament.

Clark was born in Hamilton, on the North Island. She received bachelor's and master's degrees in political science from Auckland University. She was a lecturer in political studies at the university from 1973 to 1975 and from 1977 to 1981.

Clark joined the Labour Party in 1970. She was first elected to Parliament in 1981. From 1987 to 1989, she served as minister of conservation and housing. In 1989 and 1990, she was minister of health and labour and deputy prime minister. Clark served as deputy leader of the Labour Party from 1990 to 1993, the year she was elected to replace Mike Moore as the party's leader.

Fiona Barker

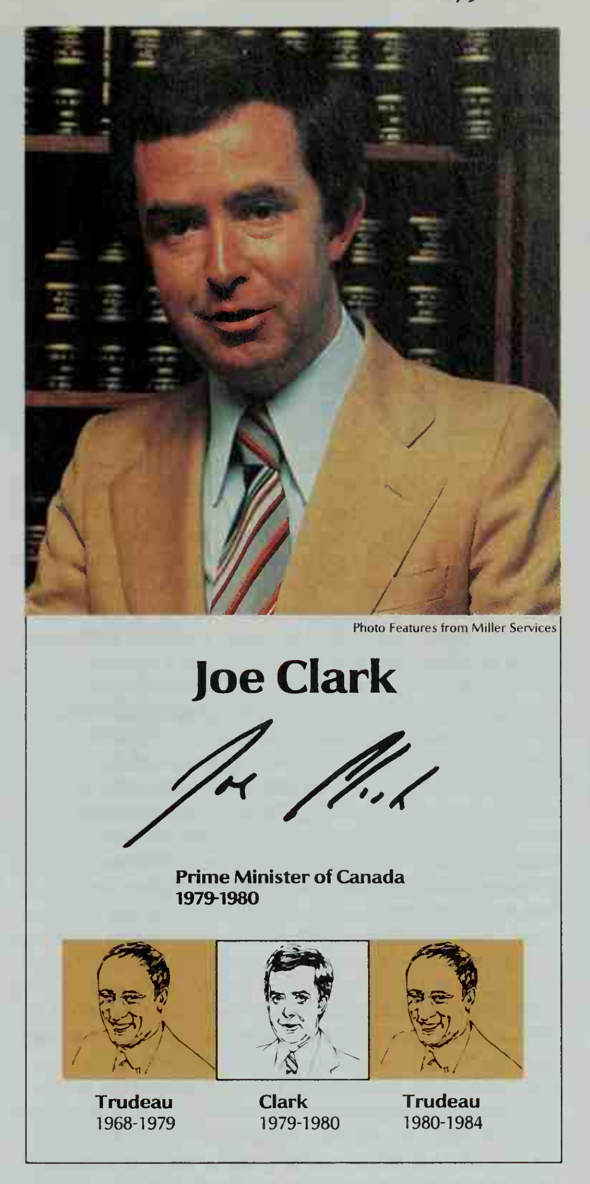


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Joe Clark

Prime Minister of Canada
1979-1980

Trudeau	**Clark**	**Trudeau**
1968-1979	1979-1980	1980-1984

Clark, Joe (1939-), became the youngest prime minister in the history of Canada. He was only 39 years old when he succeeded Pierre Elliott Trudeau in June 1979. Clark took office after leading the Progressive Conservative Party to its first national victory since 1962. But Clark's popularity fell rapidly, and Trudeau became prime minister again in March 1980.

Clark rose to national fame quickly during the 1970's. He first held public office in 1972, when voters in western Alberta elected him to the House of Commons. In 1976, the Progressive Conservative Party selected the 36-year-old Clark as its leader. Although he had only a few years of experience in public office at that time, Clark was no newcomer to politics. During the 1960's, he had held leadership positions in student political groups and worked in campaigns for Conservative candidates. From

Joe Clark raises his hands in triumph as he greets supporters on the night of the 1979 election. His wife, Maureen, stands by his side. Clark led the Conservatives to their first national victory since 1962.

Canapress

1967 to 1970, he had served as an assistant to Robert L. Stanfield, the party leader.

Clark became known as a careful thinker who was more concerned with practical solutions than with political theories. His associates respected him for his political strategy and skill as a debater. Clark had little time for recreation, but he liked to relax by reading a mystery novel or watching a movie.

Clark became prime minister at a troubled time in Canada's history. Since 1976, the provincial government of Quebec had been controlled by the Parti Québécois, a political party that favored the separation of Quebec from Canada. Many French Canadians supported separation as a way to guarantee the preservation of the French language and culture in Quebec. Clark also faced the problems of high rates of unemployment and inflation. His first challenges as prime minister were to find solutions to these and other difficulties that threatened Canada's national unity and its economic stability.

Early life

Boyhood. Charles Joseph Clark was born on June 5, 1939, in High River, Alberta, a farming community about 30 miles (48 kilometers) south of Calgary. His father, Charles A. Clark, published a weekly newspaper, the *High River Times.* Joe Clark's grandfather had started the paper in 1905, shortly after coming to the area from Kincardine, Ontario. Charles Clark met Grace Welch while both were students at the University of Alberta, and they were married in 1937. Joe was their first child. They had one other son, Peter, born in 1942.

Joe enjoyed camping, horseback riding, and the outdoors. He rarely participated in sports, but he reported on local sporting events for his father's paper. In high school, Joe showed talent for writing and public speaking. He made his first public speech at the age of 16. It won him a trip to Ottawa, where he observed Parliament in session and met John G. Diefenbaker, who later became prime minister of Canada. The trip stimulated Joe's interest in politics. His mother recalled that he returned home saying, "We don't have democracy in this country. It's run by one party, and it should have an effective and strong opposition."

Important dates in Clark's life

- **1939** (June 5) Born in High River, Alberta.
- **1960** Graduated from University of Alberta.
- **1962** Elected president of Progressive Conservative Student Federation.
- **1972** Elected to House of Commons.
- **1973** (June 30) Married Maureen McTeer.
- **1976** Chosen leader of Progressive Conservative Party.
- **1979** Became prime minister of Canada.
- **1980** Liberals defeated Progressive Conservatives. Clark resigned as prime minister on March 3.
- **1983** Succeeded as party leader by Brian Mulroney.
- **1998** Again elected leader of the Progressive Conservative Party.

College years. In 1957, Clark entered the University of Alberta, where he majored in history. He soon became active in the campus Progressive Conservative club and campaigned door-to-door for Conservative candidates in the 1958 election. In 1959, he gained valuable political experience by serving as secretary and chauffeur to the leader of the Progressive Conservative Party in Alberta.

In spite of his interest in politics, Clark devoted most of his time and energy to the student newspaper, the *Gateway.* During his third year at the university, he served as editor of the *Gateway.* In his editorials, he frequently criticized the provincial government and commented on national political issues. Clark's studies suffered because he gave so much time to journalism and politics. He graduated in 1960. He hoped to study political science at Georgetown University in Washington, D.C. But Georgetown rejected his application, and he set out on a tour of Europe in the fall of 1961.

Political career

Political worker and student. Clark returned to Canada early in 1962 to accept a job at Progressive Conservative headquarters in Ottawa. There he prepared campaign literature, wrote speeches for members of Parliament, and organized conventions. In the fall, he left his job to enter law school at Dalhousie University in Halifax, Nova Scotia. After one year, he transferred to the University of British Columbia Law School in Vancouver.

Clark disliked law school, however, and he devoted most of his time to politics both at Dalhousie and in Vancouver. In 1962, he was elected president of the Progressive Conservative Student Federation. In Vancouver, Clark also worked in an unsuccessful Conservative election campaign to gain control of the provincial government. His absorption in politics caused Clark to neglect

his schoolwork. He failed his final exams in 1964, and his law school career ended.

In the fall of 1964, Clark began the first of three years as a graduate student in political science at the University of Alberta. From 1965 to 1967, he supported himself by working part time as a teaching assistant and journalist. But politics continued to claim much of his time. In 1964, Clark helped found the Canadian Political Youth Council and served as secretary of the National Conference on Canadian Goals. From 1965 to 1967, he worked for Peter Lougheed, the Conservative leader in Alberta. Clark played a major role in developing campaign strategies that led to the election of Lougheed and five other Conservatives to the Alberta legislature in 1967.

Also in 1967, Clark himself sought election to public office for the first time. He ran for the Alberta legislature against a candidate whom political experts considered unbeatable. Clark lost, but by a remarkably small margin—only 461 votes out of nearly 13,000.

From 1967 to 1970, Clark worked in Ottawa as an assistant to Robert L. Stanfield, the leader of the Progressive Conservative Party. In his spare time, he studied French and began to develop a good command of the language. This ability later became a valuable political asset because French is the native language of more than a fourth of Canada's people.

In May 1970, Clark resigned from his job with Stanfield and began another visit to Europe. During his stay, he observed British politics, worked on his thesis for his master's degree, and continued his study of French. When he returned to Canada late in 1970, he was determined to run for Parliament as soon as possible.

Member of Parliament. In 1971, Clark decided to seek election to the Canadian House of Commons from the *riding* (district) of Rocky Mountain in western Alberta. After a hard-fought campaign, he defeated his Liberal opponent by more than 5,000 votes in the election in October 1972. Clark quickly gained a reputation in Parliament as a skilled speaker who could be both witty and aggressive in attacking Liberal Party policies.

Late in 1972, Clark hired a research assistant named Maureen McTeer, a student at the University of Ottawa. She had been active in Progressive Conservative politics. Clark and McTeer began to date in March 1973, and they were married on June 30 of that year. She and Clark have one daughter, Catherine, born in 1976.

In the election of 1974, the voters reelected Clark to the House of Commons by a wide margin. But overall, the Conservatives did poorly in the election. As a result, Stanfield decided to resign as party leader. Clark announced his candidacy in November 1975. His wife interrupted her studies at the University of Ottawa Law School to help him campaign. She became a public figure known for her support of women's rights.

Party leader. Clark faced 10 opponents in the race for party leader, and few political observers thought he would win. But his tireless campaigning and youthful, popular image carried him to victory at the party convention held in February 1976.

In his acceptance speech, Clark committed the Progressive Conservative Party to a positive style of campaigning. He declared that "Canadians today don't want to know what we're against. They want to know what we are for." As party leader, Clark called for decreased government spending, restrictions on the right of public employees to strike, and fewer economic controls.

The 1979 election. In March 1979, Prime Minister Trudeau called a general election for May. During the campaign, Clark criticized the Liberals for their failure to solve Canada's economic problems, which included inflation and high unemployment. The Progressive Conservatives pledged that a Conservative government would cut taxes, reduce government spending, and encourage private investment in the Canadian economy. Clark also proposed that the government allow homeowners to deduct part of their mortgage interest and property tax payments from their income tax.

Trudeau and the Liberals concentrated on the issue of national unity. Trudeau, a French Canadian, favored the preservation of French language and culture in Canada but firmly opposed independence for Quebec.

Clark believed the problem of national unity could not be solved by seeking a common national identity among French- and English-speaking Canadians. Instead, he urged Canadians to recognize their nation as a collection of regional cultures.

The election of 1979 ended 16 years of Liberal government. The Progressive Conservatives won 135 of the 282 seats in the House of Commons, and Clark became prime minister. The Liberals won 115 seats, and the rest went to smaller parties.

Prime minister. Clark took office as prime minister on June 4. Shortly after the election, Conservative officials indicated that they no longer favored a tax cut and that they needed to revise the deduction plan for homeowners. Opposition to Clark's government soon became widespread. The government was defeated on a vote concerning its budget, which called for a sharp increase in gasoline taxes. On Dec. 13, 1979, the House of Commons passed a motion of no-confidence in Clark's government, and the government fell from power.

Clark called a general election for February 1980. In the election, the Liberals won a majority of the seats in the House of Commons. Trudeau again became prime minister. Opposition to Clark's leadership of the Progressive Conservative Party grew. In June 1983, the party chose Brian Mulroney to replace Clark as its leader. Mulroney became prime minister in September 1984.

Later years. Clark continued working in government after serving as prime minister. From 1984 to 1991, he was secretary of state for external affairs under Mulroney. From 1991 to 1993, Clark was Mulroney's minister of constitutional affairs and president of the Privy Council. He served as a special representative of the United Nations from 1993 to 1996. He also held positions in private businesses during the mid-1990's. In 1998, Clark returned to politics and was again elected leader of the Progressive Conservative Party. In 2000, he was elected to the House of Commons from the riding of Kings-Hants in Nova Scotia. Andrew Snaddon

See also **Prime minister of Canada.**

Clark, Kenneth Bancroft (1914-), an American educator and psychologist, became known for his studies on school segregation and its effects on students. The Supreme Court of the United States referred to his work in its 1954 desegregation ruling, which declared that "separate but equal" schools for blacks are actually unequal and therefore unconstitutional.

From 1939 to 1941, Clark was part of a study of African Americans by the Swedish sociologist and economist Gunnar Myrdal. The first black to receive a permanent appointment as a professor at the City College of New York, Clark taught psychology there from 1942 to 1975.

Clark was born on July 24, 1914, in the Panama Canal Zone. He earned a Ph.D. degree from Columbia University in 1940. Two of his books are *Desegregation: An Appraisal of the Evidence* (1953) and *Dark Ghetto* (1965).

Gerald L. Gutek

Clark, Mark Wayne (1896-1984), was a leading United States general of World War II (1939-1945). He also had a major role in the Korean War (1950-1953).

Clark was born on May 1, 1896, in Madison Barracks, New York. He graduated from the U.S. Military Academy in 1917. In 1942, during World War II, he became a lieutenant general after leading a secret submarine mission to North Africa. He acquired information that was vital to the success of the 1942 Allied invasion of North Africa. He commanded the U.S. Fifth Army in its invasion of Italy at Salerno in 1943, during hard-fought battles at Cassino and Anzio, and when it entered Rome in 1944. In 1945, Clark was promoted to general. In May 1945, in northern Italy, he accepted the first major German surrender.

During the Korean War, Clark commanded the United Nations Forces and the U.S. Army in the Far East in 1952 and 1953. He took part in the signing of the armistice that ended the fighting in July 1953. James L. Stokesbury

Clark, Mary Higgins (1929-), is a popular American author of suspense fiction. Her novels and stories typically portray average women suddenly facing terrifying situations, many of them involving murder. Some of her novels explore mental illness.

Clark was born in New York City on Dec. 24, 1929. Her maiden name was Mary Higgins. She married Warren F. Clark, an airline executive, in 1949. Her first novel, *Where Are the Children?* (1975), made her a best-selling author. Clark solidified her reputation with her next novel, the thriller *A Stranger Is Watching* (1978), and went on to write more than 20 other best sellers. She has also edited mystery story anthologies. Carol Higgins Clark, her daughter, is also a best-selling suspense writer.

Clark, Ramsey. See Clark (family).

Clark, Tom Campbell. See Clark (family).

Clark, William (1770-1838), was an American explorer. With Meriwether Lewis, he led the famous Lewis and Clark expedition, which explored the Louisiana Territory and the Pacific Northwest from 1804 to 1806. President Thomas Jefferson named Lewis to lead the expedition. In 1803, Lewis invited Clark to join it. Lewis and Clark privately agreed to share command of the expedition.

The expedition started out from a camp near St. Louis in May 1804 and followed the Missouri River west. The men crossed the Rocky Mountains in 1805 and reached the Pacific coast in November that same year. They arrived back in St. Louis in September 1806. Clark made important maps of the party's route. After Lewis's death in 1809, Clark published the expedition journals.

Clark was born on Aug. 1, 1770, in Caroline County, Virginia. His brother, George Rogers Clark, became a hero in the Revolutionary War in America. After 1806, Clark held several public offices in St. Louis, including that of superintendent of Indian affairs. Gary E. Moulton

See also **Lewis and Clark expedition**.

Clarke, Arthur C. (1917-), is a British-born author of science fiction and related nonfiction. His novels are noted for their blend of scientific accuracy and spiritual optimism, and many of them describe the exploration of other worlds. The novels include *Childhood's End* (1953), his finest single work; *The City and the Stars* (1956); *Rendezvous with Rama* (1973); and *The Fountains of Paradise* (1979). With film director Stanley Kubrick, Clarke wrote the screenplay for the motion picture *2001: A Space Odyssey* (1968). He continued the series with the novels *2010: Odyssey Two* (1982), *2061: Odyssey Three* (1988) and *3001: The Final Odyssey* (1997). His short fiction was published in *Collected Stories* (2001).

Arthur Charles Clarke was born on Dec. 16, 1917, in Somerset County, England. He was the first person to propose communications satellites. In the 1950's, his book *The Exploration of Space* (1951) helped popularize the idea of space travel. His nonfiction works include *Astounding Days: A Science Fiction Autobiography* (1990). Queen Elizabeth II knighted Clarke in 1998. Neil Barron

Clarkson, Adrienne (1939-), became governor general of Canada in 1999. Born in Hong Kong on Feb. 10, 1939, she was the first immigrant to hold that post.

Clarkson moved with her family to Canada in 1942. Her original name was Adrienne Poy. She earned bachelor's and master's degrees from the University of Toronto. From 1962 to 1964, she studied at the Sorbonne in Paris. She married Stephen Clarkson, a political economist, in 1963. They divorced in the 1970's.

Clarkson began a broadcasting career in 1965. From then until 1982, she worked as a host, writer, and producer of several television programs for the Canadian Broadcasting Corporation (CBC). From 1982 to 1987, she served as Ontario's first agent-general in France. In that post, she promoted the province's business and cultural interests in France. In 1988, she returned to CBC-TV.

Clarkson has written two novels, *A Lover More Condoling* (1968) and *Hunger Trace* (1970). She also wrote a book of interviews, *True to You in My Fashion* (1971).

David Jay Bercuson

Class, Social. See Social class.

Class action is a lawsuit brought by a group of people who have similar claims. Such a group is called a *class*. Suppose that many consumers paid too high a price for a product because its few producers agreed illegally to charge similar prices. Most purchasers could not afford an individual lawsuit to recover the overcharge. But they might pool their claims and file a class action to collect damages from the companies. Classes can range from a small group of people to a statewide or nationwide class. One or more members of the class, called the *class representatives*, are the named plaintiffs in the suit and represent all other class members.

People first used class actions mainly to recover money owed them in bankruptcy cases. During the 1950's and 1960's, civil rights groups used class action to fight school segregation, job discrimination, and housing and voting restrictions. Since the 1960's, the use of class actions has expanded to all types of consumer actions. Environmental groups have used class actions to protest oil spills and other public nuisances. People have also filed class actions against gun and tobacco companies, charging that the companies acted irresponsibly in marketing harmful or dangerous products. Edward J. Kionka



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Classical music can be performed by large groups of musicians, small groups, or soloists. Many composers have written their works to be played by symphony orchestras, sometimes accompanied by a chorus. Classical music is frequently performed in large, specially designed concert halls.

Classical music

Classical music is music composed chiefly for concerts, opera, ballet, and religious services. It includes music for solo instruments, groups of instruments, voices, and both instruments and voices.

The term *classical music* is used to contrast with *popular music,* which includes country music, jazz, and rock music. *Classical* also has other meanings. Especially if it is capitalized, *Classical* refers to a style of music that developed in the later 1700's. In addition, the term describes aspects of ancient Greek and Roman civilization.

Historically, classical music includes music composed from the Middle Ages to the present day. This article discusses the major types and styles of Western classical music, as well as its history. For information about other kinds of Western music, see such *World Book* articles as **Country music, Folk music, Jazz, Popular music,** and **Rock music.** For information on the basic elements of music and the music of other cultures, see **Music.**

Instrumental music

Three main types of instrumental music are (1) solo music, (2) chamber music, and (3) orchestral music.

Solo music is music for a single instrument. Solo music has been composed primarily for keyboard instruments, but also for wind and string instruments. Popular keyboard instruments since the 1600's have been the harpsichord, clavichord, organ, and piano. Wind instruments include the flute, clarinet, oboe, and horn. String instruments include the violin, cello, and guitar. Composers have written many works for solo wind or string instruments accompanied by piano.

Short solo pieces became popular in the 1800's, especially dances and *improvisatory* works. These improvisatory pieces sound as though they were made up by the musician during the performance, but they were well planned and written in musical notation. Soloists also played *characteristic pieces,* which expressed a mood and often had descriptive titles.

Chamber music is written for a small group of musicians, each instrument playing one part. Chamber music was originally intended for performance in a room smaller and more intimate than a concert hall. Chamber music is often identified by the number of instruments, such as a duo, trio, quartet, or quintet. These small en-

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sembles are made up of string or wind instruments, or sometimes of mixed instruments. Chamber compositions are usually named according to the instruments required to play them. For example, a string quartet consists of four string instruments, typically two violins, a viola, and a cello. A *piano quintet* is made up of a piano and a string quartet.

Orchestral music is composed for small chamber orchestras and for large orchestras of 80 or more players. Small orchestras of the 1600's and 1700's consisted primarily of string instruments and harpsichord. As the orchestra grew in size in the 1700's and 1800's, it was organized into four sections—strings, woodwinds, brass, and percussion. For information on the instruments in each section, see **Orchestra** (The musicians).

The main types of orchestral music are (1) symphonies, (2) concertos, (3) overtures, (4) suites, (5) incidental music, and (6) symphonic poems.

Symphonies typically consist of four *movements* (large sections). A symphony commonly opens with an *allegro* (quick and bright) movement. The second movement is slow, and the third is moderately fast. The fourth movement returns to an allegro tempo.

Concertos. The solo concerto features one or more solo instruments, such as a piano or violin, with the accompaniment of an orchestra. The *concerto grosso* uses a small group of instruments playing in contrast to a larger string orchestra.

Overtures are orchestral pieces that open operas and oratorios. They are sometimes performed as individual concert pieces.

Suites originated in the pairing of dances during the 1500's. By the 1800's, a suite had become a series of connected instrumental movements. Many composers wrote suites for keyboard instruments and for orchestra.

Incidental music is written for use in plays. A famous example is the Norwegian composer Edvard Grieg's incidental music for *Peer Gynt* (1867), a play by the Norwegian playwright Henrik Ibsen.

Symphonic poems are one-movement compositions originated by the Hungarian composer Franz Liszt in the 1800's. Symphonic poems are inspired by subjects taken from literature, mythology, or history that are usually explained in the programs given to the audience.

Vocal music

The principal types of vocal music are (1) songs, (2) choral music, (3) operas, and (4) oratorios.

Songs are usually intended to be performed by a solo singer, sometimes accompanied by one or more instruments. Songs vary from simple folk songs to complex composed songs. Simple songs that use the same music for all stanzas of the text are called *strophic songs.* Most well-known patriotic songs are strophic songs. *Part songs* are written for two or more vocal lines, most often four or five. These multiple vocal lines are called *polyphonic.* A single vocal line is called *monophonic.*

Choral music is written for a chorus singing single-line music in unison or several vocal or instrumental parts. Most choral music is composed in parts for four voices. The voices have come to be known, from highest to lowest, as soprano, alto, tenor, and bass.

Operas are music dramas that combine solo and choral vocal music and instrumental music. They are staged like plays in which the dialogue is mostly or entirely sung. For more information on operas, see **Opera.**



Ken Firestone

A string quartet has two violinists, a viola player, and a cello player. It is one of the most common chamber music groups. Music written for such a group is also called a string quartet.

Oratorios, like operas, are dramatic works for soloists, chorus, and orchestra. Unlike operas, however, oratorios are presented in concert form without stage action, costumes, or scenery. The oratorio developed in Italy, as did opera, in the 1600's and soon spread to other countries. Most texts were based on religious themes. Probably the most famous oratorio is *Messiah* (1742) by the German composer George Frideric Handel. Two significant types of vocal music that resemble the oratorio are the *cantata* and *passion music.*

Classical music forms

Composers give form to their music by using the basic techniques of repetition and contrast of melodies, rhythms, and harmonies. Composers often vary all three during repetition of earlier material. The most important forms of classical music include *sectional form, rondo, variation, fugue, sonata,* and *free form.*

Sectional form. The basic sectional forms are *binary form* and *ternary form.* A composition in binary form has two sections. The first part typically begins in one key and then changes, or modulates, to another key. The second part begins in that key and then modulates back to the key in which the first part began. The two parts complement each other and are often repeated immediately after they are performed. A composition in ternary form has three sections: (1) a first section, (2) a contrasting second part, and (3) a repetition or varied presentation of the first section.

Rondo form is an extension of the ternary form. A first section, A, is followed by a contrasting B section, a repeat of the A section, another contrasting section, and a final A section. A five-part rondo follows the sequence A B A C A. A seven-part rondo is A B A C A B A. The composer usually changes the repetitions of the A and B materials from their first presentation for variety. The A material nearly always returns in the original key.

Variation form is also called *theme and variation* form. It consists of a principal melody called the *theme* and a number of subsequent variations on the theme

with changes in rhythm, tempo, and key. Each variation is often the same or nearly the same length as the theme. In most compositions, each variation comes to a complete close before the next variation begins. An entire composition may take the form of a theme with variations, such as Johann Sebastian Bach's *Goldberg Variations* for harpsichord. A theme with variations may also make up a movement of a larger work, such as a symphony or a string quartet.

Fugue is a technique and form of composition in which a main melody is presented in turn by different voices or instruments. In the "exposition" section of the fugue, these melodies are presented as a "subject" and "answer." Then the subject returns in other closely related keys. The fugue often ends with the subject in the original key.

Sonata refers to a composition of several movements for keyboard or for keyboard and other instruments. Sonatas often consist of three or four movements and are often similar to the symphony in structure. The first movement is usually allegro. The second movement is slower and often songlike. A third movement is moderately fast, usually a minuet or a scherzo. The final movement is fast. Composers use the four-movement plan not only for sonatas but also for symphonies and chamber music. The concerto follows a three-movement plan.

An arrangement of movements in these compositions is called *sonata plan* or *sonata cycle.* The first movement of these works, and sometimes the second and fourth movements, are written in *sonata* form, sometimes called *sonata-allegro* form. This form is written in three basic sections: the *exposition,* the *development,* and the *recapitulation.*

Free form gives the composer the greatest freedom of all. It follows no standard pattern or structure, though themes and rhythms usually recur. Free-form compositions include *preludes, fantasias,* and *rhapsodies.* Composers of the 1900's explored a variety of free forms.

History

Early music. Historians know little about music in the earliest civilizations. Musicians and musical instruments appear in a number of ancient works of art. Few examples of music were written down, however, and so it is almost impossible to know how the music sounded.

The ancient Greeks had a highly developed knowledge of music and used music in many ways. They used instrumental and vocal music in drama, religious ceremonies, and athletic games. Greek composers based their music on scales called *modes* that resembled some aspects of the major and minor scales used today. Two important early Greek instruments were the *aulos,* a wind instrument, and the *kithara,* a string instrument. The early Romans learned much about music from the Greeks and, like the Greeks, used music in many aspects of their society.
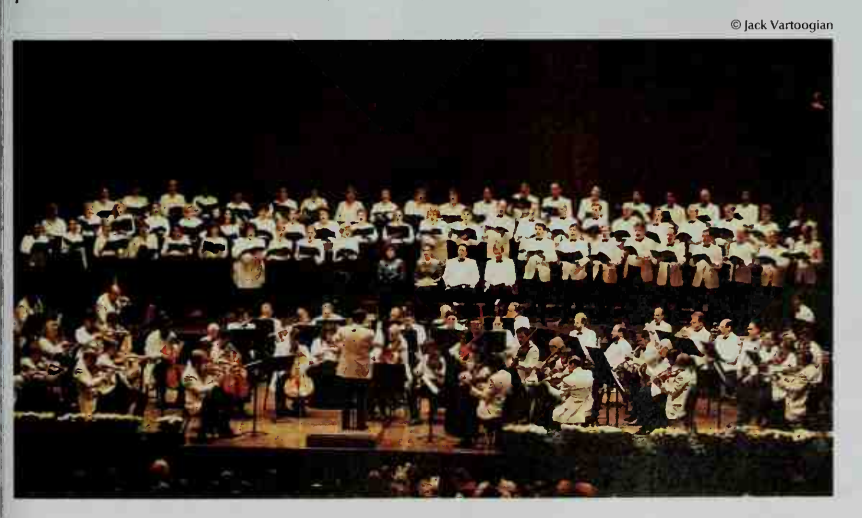
The Middle Ages in music history extended from the A.D. 400's to the early 1400's. Most surviving music of the period was composed for church services, but some was *secular* (nonreligious) music.

Church music. The first medieval music was monophonic vocal music sung by a soloist or a choir singing in unison without accompaniment. This music, called *plainsong, plainchant,* or simply *chant,* was used in Christian religious services. This music developed from several sources, including early Jewish religious music.

Pope Gregory I, who reigned from 590 to 604, was probably responsible for collecting and organizing the chants used in Christian church services. Chant came to be called *Gregorian chant* in memory of the pope.

Chant and other music of the Middle Ages was based on a harmonic system of eight scales called *church modes.* The concept and names were borrowed from scales used in ancient Greek music. Monks composed chants throughout the Middle Ages as well as the Renaissance period. However, the names of very few composers of chant are known.

Early church music was monophonic. By the 800's, composers had begun taking the first steps toward polyphonic music by adding another vocal line to an existing chant. This music is called *organum* or, in the plural, *organa.* Two of the earliest composers known by name were creators of organa, the French composers Léonin and Pérotin, also known by their Latin names Leoninus and Perotinus. They worked as musicians in the Cathedral of Notre Dame in Paris in the late 1100's and early 1200's. Their organa represented some of the finest music of their time.



Choral singing plays an important part in many works of classical music. This chorus is performing an oratorio written by the Austrian composer Wolfgang Amadeus Mozart in 1771. The composition also features major roles for vocal soloists. An orchestra accompanies the singers.

Musical notation developed during the Middle Ages. Notation is a method of writing down music so it can be read and performed. The first notation consisted of a set of symbols, called *neumes*, placed near the words as a memory aid for melody. Later, neumes were arranged higher or lower to indicate pitch. Guido d'Arezzo, an Italian monk, contributed greatly to the development of notation in the 1000's. He gave notes individual names based on their relative positions in the scale, such as *ut* (later *do*), *re*, *mi*, and *fa*.

The *mass* and the *motet* were the main religious vocal compositions during the Middle Ages. The mass set to music the standard parts of the main Christian celebration known as the Mass. The motet was a shorter, unaccompanied vocal composition based on secular texts in the 1200's and then increasingly religious texts from the 1300's through the 1500's. The motet developed from organum and became the main type of composed polyphonic music of the 1200's. The *conductus* was another religious or secular Latin song of some importance during the 1100's and 1200's. The motet and conductus were probably intended for one singer per part.

Secular music was probably popular with people from all levels of society during the Middle Ages. Medieval songwriters based their texts on love and aspects of nature. In French-speaking areas, courtly poet-composers called *troubadours* and *trouvères* became famous for their songs in the 1100's and 1200's. In German-speaking countries, *Minnesingers* were the counterparts of the trouvères from the 1100's to the 1300's. Their songs had no written instrumental accompaniment, but musicians sometimes may have improvised accompaniments.

The music of the 1300's in France became known as the *Ars Nova* (new art). The name was the written description of music by Philippe de Vitry, a French composer and poet, about 1320. Ars Nova featured greater variety of rhythm and more independence in part writing. Vitry and his famous contemporary Guillaume de Machaut of France wrote motets with complex rhythmic organization. Machaut also composed monophonic and polyphonic chansons of high quality. His *Notre Dame Mass* was the first polyphonic setting of the parts of the Ordinary of the Mass. This work, his songs, and his motets set him apart as one of the first great composers in Western culture.

In England, significant musical activity took place in the 1400's with such composers as Leonel Power and John Dunstable. They, too, wrote motets, masses, and secular songs of high quality.

Music in Italian areas began to flourish in the middle to late 1300's. Many masses, motets, and Italian secular songs of high artistic merit were written. Francesco Landini was one of several leading Italian composers of that time.

A contemporary of Dunstable in France was Guillaume Dufay. He was a leading composer of masses and also wrote secular songs with French texts. Dufay's music had a great influence on performers and composers of the next generation in France and the Netherlands.

The Renaissance. In Western music, the transition to the Renaissance began in the early 1400's. The Renaissance style lasted through the 1500's. Most composers of the Renaissance began their careers as singers in cathedral or chapel choirs. They studied music and composition while they acquired general education. Gradually, secular music gained in importance.

The development of printing in the West during the 1400's had a major impact by making written music more available. The printing of music developed rapidly and soon replaced the older system of copying by hand.

Franco-Flemish music. Many developments in music occurred in Flanders, a region that included parts of what are now Belgium, the Netherlands, and northern France. Johannes Ockeghem and Jacob Obrecht, both born in Flanders, were two major Flemish composers at the end of the 1400's. They held positions as composer or musical director with royal and wealthy families in France and Italy.

Josquin Desprez was one of the greatest composers of the Renaissance. He was born in northern France but lived in Italy for many years. Desprez wrote masses, motets, and secular compositions during the late 1400's and early 1500's.

Many Franco-Flemish composers held important positions with the church and nobility in Italy. During the 1500's, young Italian composers studied with them and began to emerge as capable composers.

Italian music. Giovanni Palestrina, in particular, became a master of polyphonic music. He wrote about 250 motets and about 100 masses.

Italian vocal compositions called *madrigals* developed as a major type of secular polyphonic song in the 1500's. Costanzo Festa, Luca Marenzio, and Claudio Monteverdi wrote madrigals for three to five unaccompanied voices. Most madrigals dealt with romantic themes, using Italian poetry about love, nature, and mythology.

Music in other countries. At the end of the 1500's, the Italian madrigal spread to England, where it was adapted to English texts. Soon the madrigal became popular in England through the compositions of William Byrd, Thomas Morley, and others.

In France, the chanson thrived in the 1500's, with composers writing in a new style that featured quick, strong rhythms. The style is often called the *Parisian chanson*. Leading composers were Claudin de Sermisy and Clément Janequin.

Instrumental music. Composers also wrote instrumental music in the 1500's. Dances of many types flourished. Composers created new types of instrumental works from vocal forms. Two new types of instrumental music were the *canzona,* which developed from the French chanson, and the *ricercare,* which resembled the motet.

Orlando di Lasso and Philippe de Monte were the last Franco-Flemish master composers at the end of the 1500's. Lasso, also known by his Flemish name Roland de Lassus, composed almost 2,000 works, including masses, chansons, and motets. Monte also wrote more than 1,200 secular choral pieces.

The Reformation was a religious revolution that produced a number of new musical concepts in the second half of the 1500's. In Germany, the Reformation leader Martin Luther and his followers wanted worshipers to participate more actively in church services. They especially wanted people to sing more and in local languages instead of the traditional Latin. To meet these goals, composers created the *chorale,* a hymn with Ger-

man words sung in unison by the congregation.

In Switzerland, Reformation leader John Calvin and his followers believed that only Biblical texts should be sung in church. They set to music poems from the Bible called Psalms, first in French and then in other languages as the Reformation spread to other countries.

Similar changes came about in the Church of England during the reign of King Henry VIII in the mid-1500's. A change to the use of English in church services was followed by development of the *Service* and the *anthem*, new types of liturgical music that gained prominence.

The Baroque period in Western music extended from the early 1600's through the mid-1700's, though its roots date from the late 1500's. During the Baroque period, new types of instrumental works developed, especially in Italy. These works included the sonata, concerto, suite, and fugue. New types of vocal music also emerged, such as *monody*, a song style with a single melodic line and chordal instrumental accompaniment. The longer and more complex cantata, opera, and oratorio also appeared.

Andrea Gabrieli and his nephew Giovanni were composers who worked as organists at St. Mark's Church in Venice, Italy. They both composed innovative works that influenced many Baroque composers. Giovanni became noted for his motets with instrumental accompaniment.

Baroque music was characterized by the use of chord-playing instruments, such as the harpsichord or organ, and low-pitched instruments, such as the viola de gamba or cello, to play the bass line. This group was called *basso continuo* or just *continuo*. Numbers were often added beneath notes in the bass line to show keyboard players the chords they should play.

Major Italian composers of the Baroque era included Giovanni Gabrieli, Claudio Monteverdi, Arcangelo Corelli, Alessandro Scarlatti, and Antonio Vivaldi. The major French composers of this period were Jean-Baptiste Lully and Jean-Philippe Rameau, both of whom were active in developing French opera. Writing for keyboard instruments became important in France. François Couperin and Nicolas de Grigny wrote major works for harpsichord and organ.

Music for harpsichord was highly regarded in England in the 1600's. William Byrd and Orlando Gibbons were major composers for the instrument. In the later 1600's, Henry Purcell excelled in composing for the stage. His opera *Dido and Aeneas* (1689) is one of the finest English works of the period.

German Baroque composers wrote nearly every type of music. Heinrich Schütz was especially gifted in writing sacred music. Georg Philipp Telemann wrote over 1,000 cantatas along with other vocal music.

Johann Sebastian Bach and George Frideric Handel brought German Baroque music to its peak. Bach excelled in works for organ and harpsichord, chamber music, concertos, cantatas, oratorios, motets, and masses. Handel is especially noted for his Italian operas and oratorios in English.

The Classical period. In the mid-1700's, a new musical style developed. Often referred to as *galant*, the style was elegant and graceful, emphasizing prominent melodies supported by light accompaniment. This style grew into the Classical style, which flourished into the early 1800's. The Classical style was noted for its clarity,

Highlights in the history of classical music

c. 3000 B.C. The Sumerians played music on harplike instruments.

c. 500 B.C. The Greeks began to develop systems of music theory.

A.D. 400's B.C. Western European composers started to create polyphonic music.

c. 800 Plain song became the chief music of Christian worship.

1100's and 1200's Composers in Paris introduced the earliest system for writing down rhythmic values.



(c) Loyola University Chicago: R. V. Schoder, SJ

The kithara was an important stringed instrument of ancient Greece. The Greeks believed that music played on the kithara had a calming effect on listeners.



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Guido d'Arezzo, *left*, an Italian monk, developed a revolutionary system of notation and method of sight-singing in the A.D. 1000's.



Granger Collection

Troubadours often performed for royalty during the 1100's and 1200's in southern France. These poet-musicians helped popularize nonreligious songs.

balance, and regularity. By the mid-1700's, these qualities could be heard in the sonata, chamber music, concerto, and symphony. During the Classical era, both instrumental and vocal music flourished. Opera became increasingly popular.

The major composers of instrumental music during the Classical period were Wolfgang Amadeus Mozart and Joseph Haydn of Austria and Ludwig van Beethoven of Germany. Each also wrote superb masses. In addition, Mozart was one of the greatest opera composers.

Many Classical composers wrote for the piano, which was invented in the early 1700's and became increasingly popular. Beethoven's piano sonatas rank among the masterpieces written for the instrument. The harpsichord declined in popularity in the late 1700's and was ignored until it was revived in the mid-1900's by composers and performers.

The Romantic era. In the early 1800's, music became more varied, intense, and expressive. The style of this music became known as Romantic. The Romantic style was not a revolt against the Classical style but an expansion of it. Beethoven's later works show his growth from the clarity and directness of the Classical style to an increasingly complex and emotional Romantic style.

Romantic composers favored short works for soloists or small performing groups, and large works for orchestra and choir, which increased greatly in size. Pieces for solo piano and solo songs with piano accompaniment were especially popular. Composers in German-speaking countries were inspired to write great songs due to the rising popularity of the piano and the availability of great poetry. Franz Schubert of Austria excelled at composing art songs—called *Lieder* in German. The songs reflect Schubert's skill and sensitivity in setting fine poetry to lyrical, easily sung melodies.

The piano's expressive and dramatic qualities made that instrument an ideal instrument to support a solo voice. Schubert and the German composer Robert Schumann were among the composers who wrote *song cycles,* collections of songs related by a theme in the texts and sometimes by repeated melodic material. Short piano pieces and dances and longer pieces, especially the sonata, became increasingly popular. People enjoyed piano music, either in solo performance or with other instruments. The piano became the most popular instrument, for both the virtuoso and the amateur. Masterpieces of piano music were composed by Beethoven, Schumann, Johannes Brahms, and Felix Mendelssohn of Germany; Schubert of Austria; Frédéric Chopin of Poland; and Franz Liszt of Hungary.

Longer compositions for large performing groups were also popular in the 1800's. These works were mainly symphonies, concertos, masses, and oratorios. The great symphony composers included Germany's Beethoven and Brahms; France's Hector Berlioz; and Austria's Schubert, Anton Bruckner, and Gustav Mahler. Concertos for solo piano or violin and orchestra were written for virtuoso performers. Operas became longer, more dramatic, and more romantic in the works of Richard Wagner in Germany and Giuseppe Verdi and Giacomo Puccini in Italy.

The hero was important in Romantic literature. In the same way, music lovers idolized the highly skilled soloist in Romantic music. Audiences thrilled to Chopin

1300's — Guillaume de Machaut of France wrote the first polyphonic mass composed by a single person.

1597 — Jacopo Peri of Italy composed *Dafne,* probably the first opera.

1600's — The modern system of major and minor scales came into use.

1722 — Johann Sebastian Bach of Germany completed Book I of the *Well-Tempered Clavier.*

1722 — Jean-Philippe Rameau, a French music theorist, published *Treatise of Harmony.*



Detail of a relief sculpture (1431-1438) by Luca della Robbia (SCALA Art Resource)

During the Renaissance period, choirs consisted entirely of male singers. This marble sculpture shows a choir of boys singing a psalm.



Detail of *Psalms of Penitence* (1565-1570), a miniature painting on parchment by Hans Mielich; Bayer. Staatsbibliothek, Munich, Germany

Chamber music flourished during the 1500's. This chamber orchestra featured composer Orlando di Lasso of Flanders at the keyboard.



Detail of a German engraving (1732) (Granger Collection)

Johann Sebastian Bach composed many masterpieces during the first half of the 1700's. He is shown here conducting a performance of chamber music.

and Liszt as great pianists, and to the Italian composer-violinist Niccolò Paganini.

Romantic composers wrote the same types of music that had been favored in the Classical style. They also devised new types of short piano pieces, such as the *nocturne* and the *intermezzo*. The symphony developed along two paths. One was the *abstract* or *absolute symphony* that had purely musical content. The other was the *program symphony*, which explored a literary idea or presented a pictorial scene. The only larger work that was new in the Romantic era was the symphonic poem.

In the later 1800's, many European composers began to feature national elements in their music. They used folk songs, folk dances, and national legends and folk tales in operas and other music. This nationalistic trend continued well into the 1900's. Outstanding nationalistic composers included Edvard Grieg of Norway, Modest Mussorgsky of Russia, and Isaac Albéniz of Spain.

The 1900's. Composers of the 1900's developed many new styles of music. Some composers, such as Igor Stravinsky, explored several styles.

Impressionism. Claude Debussy in France developed a new style of music that came to be called Impressionism. This style expanded the limits of *tonality* (centering harmony around one pitch—C major) with unusual and rich harmonies, and different types of scales and chord progressions. Debussy was friends with many Impressionist painters and Symbolist poets of the later 1800's. His music, like their paintings and poems, emphasized impressions of moods, emotions, and atmospheric effects rather than realistic details.

Music in the early 1900's was a blend of the old and the new. Late Romantic styles continued in the works of many composers who used new and fresh harmonic approaches. Nationalism continued in the works of such composers as Ralph Vaughan Williams of England, Béla Bartók of Hungary, Charles Ives and Aaron Copland of the United States, and Sergei Prokofiev and Dimitri Shostakovich of Russia (later part of the Soviet Union). Bartók's piano and orchestra works rank among the most impressive works of the early 1900's.

Igor Stravinsky was a Russian-born composer who explored several styles and approaches to music. His early works were strongly nationalistic, such as his ballet *The Firebird* (1910), based on Russian fairy tales. Stravinsky's influential ballet *The Rite of Spring* (1913) portrays a fertility ritual. Although the music is fundamentally tonal, it abandons traditional harmonies to explore *dissonance*. Composers create dissonance by combining notes and chords that create harsh or restless sounds.

Neoclassicism blends characteristics of earlier music with distinctly modern traits. Stravinsky turned to Neoclassicism in many of his works, such as his ballet *Pulcinella* (1920). *Pulcinella* uses passages from the music of Giovanni Pergolesi, an Italian composer of the early 1700's, and adds Stravinsky's own orchestration and other personal touches. Other Neoclassical composers were Paul Hindemith in Germany and Béla Bartók.

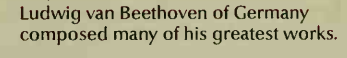
Atonal music. By 1908, the German composer Arnold Schoenberg had become discontented with using tonality in his compositions. Schoenberg experimented with *atonal* music, which has no central key and is extremely dissonant.

1742 — *Messiah,* an oratorio by George Frideric Handel of Germany, was first performed.

1787 — Wolfgang Amadeus Mozart of Austria wrote the opera *Don Giovanni.*

1794 — The Austrian composer Joseph Haydn completed his "London" Symphonies.

Early 1800's — Ludwig van Beethoven of Germany composed many of his greatest works.





Detail of *Leopold Mozart with His Two Children* (about 1765), an oil painting on canvas by Louis Carrogis; Carnavalet Museum, Paris (Giraudon/Art Resource)

As a young boy, Mozart showed extraordinary musical talent. This painting portrays him playing the piano, accompanied by his father and sister.



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Beethoven's studio. Beethoven worked in this studio in his home during his final years. Although he became totally deaf, he continued to compose great music.



Granger Collection

Franz Schubert of Austria wrote brilliant piano solos, chamber music, and symphonies. Here he is sitting at the piano, *lower left,* in a friend's home.

In the 1920's, Schoenberg formulated a system of atonal music called *twelve-tone music* or *serialism.* All 12 notes of the scale get equal emphasis, with no notes dominating, as they do in major or minor keys. Twelve-tone music became the basis for most of Schoenberg's music in the 1930's and 1940's. Schoenberg's innovative works aroused protests from audiences and conservative composers and critics. However, serialism had a strong influence on other composers of the 1900's. This influence is seen mainly in the music of two of Schoenberg's students, Austrian composers Anton Webern and Alban Berg.

In the 1940's, Olivier Messiaen of France and Milton Babbitt of the United States independently developed *total serialism.* In this style, the composer arranges other aspects of the music in addition to pitch, such as rhythm and duration, in a certain order or series.

Experimental music. Many composers wrote for traditional instruments but used them in unorthodox ways to create new, fresh sounds. In the mid-1900's, Henry Cowell of the United States based several works on the music of Japan, India, and ancient Persia. Cowell also created new sounds with the piano by scraping, slapping, plucking, and sweeping the open strings with the hand.

John Cage of the United States developed one of the most inventive musical minds of the middle and late 1900's. As a young composer, he was influenced by the French-born composer Edgard Varèse, developing new styles and forms of percussion music. Cage became famous for his *prepared piano,* in which several strings were muted with pieces of wood, metal, rubber, or glass.

Cage also helped develop *aleatory,* or *chance, music,* in which all or part of the sounds depend on last minute choices by the performer. The composer provides only a general outline of the piece. The music leaves the performers largely free to create melodies and rhythms that vary with each performance.

Electronic music was explored by composers early in the 1900's. In electronic music, the composer uses electronic equipment to create sounds that have any desired pitch, loudness, tone, and duration. Pierre Schaeffer of France created a forerunner of electronic music that he called *musique concrète* about 1948. Schaeffer recorded natural sounds, such as instruments, voices, and noise, and then manipulated the recording to achieve the sound he desired. Although not truly electronic, this early work solved some of the problems for later composers working with electronically generated sounds.

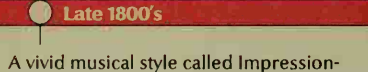
Electronic music studios emerged in radio stations in Europe and then in universities in the United States in the 1950's. Some composers found that only electronic instruments, such as the synthesizer, provided the new sounds they desired. Other composers successfully combined traditional musical instruments with electronically generated sounds recorded on tape. Mario Davidovsky, an Argentine-born American composer, created many significant works in this way.

Third-stream music combined the harmonic qualities of classical music with the rhythmic and improvisational elements of jazz, blues, ragtime, and other forms of popular music. The American composer George Gershwin combined classical and popular forms in some of his compositions, but the term generally refers to music be-

The Polish-born composer Frédéric Chopin wrote outstanding compositions for solo piano.

Johannes Brahms of Germany composed brilliant symphonies in the style of Beethoven.

Mid-1800's



Richard Wagner of Germany created operas that featured *leitmotifs* (recurrent themes).

A vivid musical style called Impressionism developed in France.



Granger Collection

Hector Berlioz ranked as the leading French musician of the Romantic period. He became famous throughout Europe as a composer, conductor, and music critic.



Bettmann Archive

The Ring of the Nibelung, a group of operas by Wagner, was first performed in its entirety in 1876. This painting shows a scene from that performance.



All-Union Association Vneshtorgizdat, Moscow

Swan Lake, one of the world's great ballets, premiered in Moscow in 1877. Peter Ilich Tchaikovsky of Russia composed the music for this ballet.

ginning in the 1950's. The American composer Gunther Schuller invented the term and created music in that style. Other composers of third-stream music included the Americans William Bolcom and John Lewis.

Minimalism began in the 1960's. Minimalist composers repeated melodies, rhythms, and harmonies with small, gradual changes. These repeated patterns often create a hypnotic effect. The American composers Steve Reich and Philip Glass became known for this style.

Classical music today

Many composers of the 1900's wrote challenging, often atonal, works without considering the taste of their audience. By the late 1900's and early 2000's, however, composers seemed increasingly interested in writing music to please their listeners. Leading practitioners of a return to tonality were the American composers John Adams and David Del Tredici. Adams began his career as a Minimalist and then turned away from that style. Del Tredici used folk music and rock music in many compositions.

John Corigliano of the United States won acclaim for his film scores as well as his orchestral works. The Americans Joan Tower and Ellen Taaffe Zwilich are two of the most successful women composers in history.

Daniel T. Politoske

Related articles in *World Book.* See the *Arts* section of the articles on various countries, such as **Mexico** (Arts). See also:

Biographies

For biographies of other persons relating to classical music, see the lists of *Related articles* at the end of **Hymn; Opera; Orchestra; Piano;** and **Violin.** See also:

American composers

Barber, Samuel
Bernstein, Leonard
Billings, William
Blitzstein, Marc
Bloch, Ernest
Cage, John
Carter, Elliott
Copland, Aaron
Cowell, Henry
Crumb, George
Dello Joio, Norman
Gershwin, George
Glass, Philip
Gottschalk, Louis M.
Gould, Morton
Grofé, Ferde
Hanson, Howard
Harris, Roy
Hovhaness, Alan
Ives, Charles E.
MacDowell, Edward Alexander
Menotti, Gian Carlo
Moore, Douglas S.
Piston, Walter
Schuman, William
Sessions, Roger
Still, William Grant
Thomson, Virgil
Varèse, Edgard
Zwilich, Ellen Taaffe

Austrian composers

Berg, Alban
Bruckner, Anton
Czerny, Karl
Haydn, Joseph
Kreisler, Fritz
Mahler, Gustav
Mozart, Wolfgang
Schoenberg, Arnold
Schubert, Franz P.
Strauss, Johann, Sr.
Strauss, Johann, Jr.
Webern, Anton

British composers

Britten, Benjamin
Byrd, William
Delius, Frederick
Dowland, John
Elgar, Sir Edward W.
Gibbons, Orlando
Holst, Gustav
Morley, Thomas
Purcell, Henry
Sullivan, Sir Arthur S.
Tallis, Thomas
Vaughan Williams, Ralph
Walton, Sir William

French composers

Berlioz, Hector
Bizet, Georges
Boulez, Pierre
Couperin, François
Debussy, Claude
Delibes, Léo
Dukas, Paul A.
Fauré, Gabriel U.

1920's Arnold Schoenberg of Austria developed *serialism,* a method of composition based on all 12 notes of the scale.

1930's Dimitri Shostakovich developed a sophisticated modern style of Russian music.

1958 Edgard Varése, a French-born composer, produced *Poème Electronique,* the first major work of electronic music.

2000 The American composer John Corigliano completed his Symphony No. 2 for string orchestra.



© Jack Vartoogian

The Firebird is a ballet composed by Russian-born Igor Stravinsky. The ballet was first performed in 1910. Stravinsky based the work on Russian folklore.



Stock Montage

Wozzeck, an opera by Alban Berg of Austria, caused a sensation at its premiere in 1925. This picture shows a performance in Germany in 1931.



© Ron Scherl, Stage/Image

Electronic music is composed with special electronic equipment. American composer John Coolidge Adams is creating music on an electronic keyboard.

Franck, César
Gounod, Charles
Honegger, Arthur
Ibert, Jacques
Lully, Jean-B.
Massenet, Jules
Messiaen, Olivier
Milhaud, Darius
Offenbach, Jacques
Poulenc, Francis
Rameau, Jean-Philippe
Ravel, Maurice
Saint-Saëns, Camille
Satie, Erik

German composers

Bach, Carl Philipp Emanuel
Bach, Johann Christian
Bach, Johann Sebastian
Beethoven, Ludwig van
Brahms, Johannes
Bruch, Max
Buxtehude, Dietrich
Gluck, Christoph Willibald
Handel, George Frideric
Henze, Hans Werner
Hindemith, Paul
Humperdinck, Engelbert
Mendelssohn, Felix
Meyerbeer, Giacomo
Orff, Carl
Schumann, Clara
Schumann, Robert
Stockhausen, Karlheinz
Strauss, Richard
Telemann, Georg Philipp
Wagner, Richard
Weber, Carl Maria von

Italian composers

Bellini, Vincenzo
Berio, Luciano
Boccherini, Luigi
Boito, Arrigo
Cherubini, Luigi
Clementi, Muzio
Corelli, Arcangelo
Dallapiccola, Luigi
Donizetti, Gaetano
Leoncavallo, Ruggiero
Mascagni, Pietro
Monteverdi, Claudio
Paganini, Niccolò
Palestrina, Giovanni
Pergolesi, Giovanni B.
Puccini, Giacomo
Respighi, Ottorino
Rossini, Gioacchino A.
Scarlatti, Alessandro
Scarlatti, Domenico
Tartini, Giuseppe
Verdi, Giuseppe
Vivaldi, Antonio

Russian composers

Borodin, Alexander
Glinka, Mikhail I.
Khachaturian, Aram I.
Mussorgsky, Modest
Prokofiev, Sergei S.
Rachmaninoff, Sergei V.
Rimsky-Korsakov, Nikolai
Rubinstein, Anton G.
Scriabin, Alexander
Shostakovich, Dimitri
Stravinsky, Igor
Tchaikovsky, Peter I.

Other composers

Albéniz, Isaac
Bartók, Béla
Chávez, Carlos
Chopin, Frédéric F.
Desprez, Josquin
Dvořák, Antonín
Falla, Manuel de
Ginastera, Alberto
Grainger, Percy A.
Grieg, Edvard
Janáček, Leoš
Kodály, Zoltán
Lasso, Orlando di
Liszt, Franz
Nielsen, Carl A.
Paderewski, Ignace J.
Penderecki, Krzysztof
Sibelius, Jean
Smetana, Bedřich
Villa-Lobos, Heitor

Elements of music

Counterpoint
Harmonics
Harmony
Key
Pitch
Rhythm
Sound
Tone

Instrumental musical forms

Concerto
Étude
Fantasia
Fugue
Intermezzo
March
Minuet
Overture
Rondo
Scherzo
Serenade
Sonata
Suite
Symphonic poem
Symphony
Variation
Waltz

Vocal music

Ballade
Barcarole
Bard
Canon
Cantata
Chorale
Hymn
Lieder
Madrigal
Meistersinger
Minnesinger
Minstrel
National anthem
Opera
Operetta
Oratorio
Passion music
Singing
Song
Troubadour
Trouvère
Voice

Other related articles

Aleatory music
American Society of Composers, Authors and Publishers
Ballet
Baroque (Baroque music)
Cecilia, Saint
Chamber music
Composer
Electronic music
Greece, Ancient (The arts)
Metronome
Music Clubs, National Federation of
Orchestra
Pulitzer Prizes (Music)
Romanticism (Romanticism in music)
Suzuki method
Treble
Tuning fork
Western frontier life in America (Music)

Outline

I. **Instrumental music**
   A. Solo music
   B. Chamber music
   C. Orchestral music
II. **Vocal music**
   A. Songs
   B. Choral music
   C. Operas
   D. Oratorios
III. **Classical music forms**
   A. Sectional form
   B. Rondo
   C. Variation
   D. Fugue
   E. Sonata
   F. Free form
IV. **History**

Questions

What was chant?
What are the main types of orchestral music?
What major new styles of music developed in the early 1900's?
What is chamber music?
What is the major difference between an opera and an oratorio?
Who were the major composers of instrumental music during the Classical era?
What are the main techniques that composers use to give structure to their music?
How is the sonata form arranged?
What is aleatory music? Electronic music?
What is a symphonic poem?

Additional resources

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Classicism is a philosophy of art and life that emphasizes order, balance, and simplicity. The ancient Greeks were the first great classicists. Later, the Romans, French, English, and others produced classical movements. Each group developed its own unique characteristics, but all reflected certain common ideals of art, humanity, and the world.

The qualities of classicism

Classicism contrasts with the philosophy of art and life called *romanticism*. Classicism stresses reason and analysis, while romanticism stresses imagination and the emotions. Classicism seeks what is universally true, good, and beautiful. Romanticism seeks the exceptional and the unconventional. Classical art looks to the past for its models. It often revives ancient Greek and Roman values, and is then called *neoclassicism*. Romanticism is often sympathetic to revolutions in society and art. Classical artists follow formal rules of composition more closely than romantic artists do. See **Romanticism**.

Classicists know that reality is complex. But they try to approach it through simple structures. For example, the classical playwright concentrates on essentials by restricting a play to a single line of action that could happen within one day, in one place, or in nearby places.

The Italian artist Raphael and the French artist Nicolas Poussin painted pictures illustrating the finest qualities of classical art. Many of their pictures have a poetic mood, but the organization of the subject matter is always balanced, harmonious, and orderly. These qualities can be seen in Raphael's *Madonna of the Goldfinch* and Poussin's *Holy Family on the Steps*. Both of these pictures are reproduced in the **Painting** article. The works of the Italian composer Giovanni Palestrina and the French composer Jean-Philippe Rameau show the classical qualities of balance and clarity.

Great classical movements

The first important classical movement developed in ancient Greece and Rome. Another such movement appeared in Western Europe in the 1600's and 1700's.

Greece. The first classical period in the West arose in ancient Greece, and reached its height in the 400's and 300's B.C. The Greeks praised reason and denounced emotionalism and exaggeration. They tried to see all reality within a unified system that gave it meaning and direction. Greek artists showed the beauty of the human form. The sculptures of Phidias and Praxiteles are magnificent examples of proportioned human figures. Aeschylus, Sophocles, and Euripides wrote tragedies about the power of fate and the danger of excessive pride. See **Greek literature; Greece, Ancient** (The arts).

Rome. Roman classicism developed in two stages. These stages occurred during the age of Cicero from 80 to 43 B.C., and the age of Augustus from 37 B.C. to A.D. 14. The Romans adopted the Greek classical values, and added a unique emphasis on civilization as an organized, cooperative undertaking. Under the influence of the statesman and orator Cicero, civic responsibility gained a new importance. Rome's literature reached its highest achievement during the reign of Augustus. The classical poet Virgil wrote works on the development of civilization and on the heritage of Rome. The works of the classical poet Horace exemplify civilized attitudes toward society and life. See **Latin literature**.



The Father of Psyche Sacrificing at the Temple of Apollo (1670); an oil painting on canvas (Jeremy Witaker, National Trust Photographic Library)

A French classical landscape of the 1600's by Claude reflects the movement's admiration for balance, harmony, and order. The idealized rural setting and the subject matter taken from Greek mythology were also typical of French classical painting.

France. The French classical movement of the 1600's developed the most diverse expression of classical values ever seen in the Western world. French classicists placed especially strong emphasis on reason and the intellect in analyzing ideas and human actions. The most important people in the intellectual and literary history of the French classical period include the mathematician-philosophers Blaise Pascal and René Descartes; the moralist writer Duc de La Rochefoucauld; the writer of fables Jean de La Fontaine; and the dramatists Pierre Corneille and Jean Racine. See **French literature** (The classical age).

England. The English classical period followed French classicism. It arose in the late 1600's and reached its height during the first half of the 1700's. The English modeled their movement on the classicism of France, Greece, and Rome. They strove for good taste and truth to nature. For a more detailed discussion of English classicism, see **English literature** (The Augustan Age).

Germany. In Germany and in German-speaking Austria, music rather than literature best expressed classical ideals. Joseph Haydn, Wolfgang Amadeus Mozart, and Ludwig van Beethoven rank among the great classical composers (see **Classical music**). In the late 1700's in Germany, a classical literature flourished side by side with romantic literature. Johann Wolfgang von Goethe is often regarded as the finest classical and the finest romantic German writer. Lawrence Lipking

There is a separate article in *World Book* for each person discussed in this article. See also **Russian literature** (The classical movement).

Classification, Scientific. Scientific classification is a method scientists have developed to arrange all of the world's organisms in related groups. It is the orderly arrangement of all living things. Scientific classification indicates certain relationships among all organisms. Detailed scientific classifications also show how ancient and extinct biological groups fit into this arrangement. The classification of organisms is a science called *taxonomy* or *systematics*.

Scientific classification is an interpretation of facts. It is based on the opinion and judgment a biologist forms after studying many living and preserved dead organisms. Most biologists use the same basic framework for classification. But not all biologists agree on how different groups of organisms fit into this scheme, and so classifications often differ in details.

The language of classification. Latin and Greek words are used in scientific classification, because early scholars used these languages. Every known organism belongs to a particular *species.* Each species has a two-part scientific name. Most of these names come from Greek or Latin words. We call this system of names the *binomial system of nomenclature,* or *binomial nomenclature.* These are Latin terms that mean *two-name naming.* The two names identify an organism by indicating which species it belongs to.

Organisms are known by different common names in different regions of the world. However, each organism has only one correct scientific name, and scientists anywhere in the world can recognize the organism by its scientific name. For example, the same large member of the cat family may be known in various parts of North America and South America as a puma, cougar, mountain lion, panther, or león. The cat's scientific name is *Felis concolor.* Scientists can identify the animal by that name no matter what language they speak.

International commissions of scientists establish the rules for adopting scientific names. Some scientific names are descriptive. The scientific name of the spotted skunk, for example, is *Spilogale putorius,* which means *smelly, spotted weasel.* But many scientific names have no descriptive meaning.

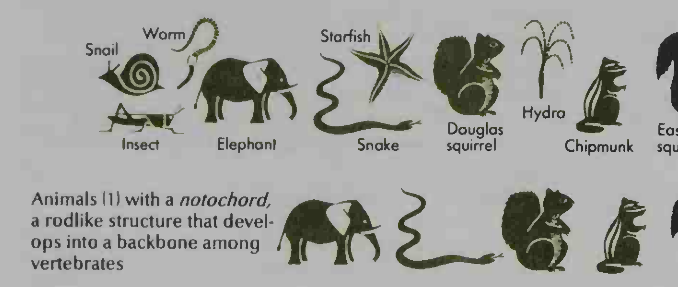
Groups in classification. Seven chief groups make up a system in scientific classification. The groups are: (1) kingdom, (2) phylum or division, (3) class, (4) order, (5) family, (6) genus, and (7) species. The kingdom is the largest group. The species is the smallest. Every known organism has a particular place in each group.

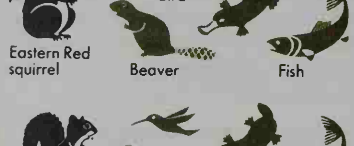
Kingdom is the largest unit of biological classification. Until the 1960's, most biologists formally recognized only two major kingdoms—Animalia, the animal

How organisms are classified

The illustrated tables below are simplified examples of classification. They show how a red squirrel (*Tamiasciurus hudsonicus*) and a common buttercup (*Ranunculus acris*) can be separated from any other species of animal or plant. As you go down the tables, from kingdom to species, the animals and plants in each group have more and more features in common. The captions list these features. Individuals in a species have so many similar features that they look alike.

Animal kingdom





Kingdom
Animalia

Animals (1) with a *notochord,* a rodlike structure that develops into a backbone among vertebrates

Phylum
Chordata

Animals (1) with a notochord that (2) *nurse* (feed milk to) their young



Class
Mammalia

Animals (1) with a notochord that (2) nurse their young, and have (3) long sharp front teeth



Order
Rodentia

Animals (1) with a notochord that (2) nurse their young, and have (3) long sharp front teeth and (4) bushy tails



Family
Sciuridae

Animals (1) with a notochord that (2) nurse their young, have (3) long sharp front teeth and (4) bushy tails, and (5) climb trees



Genus
Tamiasciurus

Animals (1) with a notochord that (2) nurse their young, have (3) long sharp front teeth and (4) bushy tails, (5) climb trees, and (6) have brown fur on their backs and white fur on their underparts



Species
Tamiasciurus hudsonicus

kingdom, and Plantae, the plant kingdom. But as more information about the microscopic structure and biochemistry of organisms became known, scientists realized that a two-kingdom classification system was not exact enough. Today, most biologists use a system that recognizes five kingdoms of organisms. These are Animalia, Plantae, Fungi, Protista, and Prokaryotae.

The kingdom Animalia is the largest kingdom. It has more than 1 million named species. These species include the organisms that most people easily recognize as animals, such as human beings, deer, fish, insects, and snails. The kingdom Plantae consists of more than 260,000 known species. It includes those organisms that most people easily recognize as plants, such as magnolias, sunflowers, grasses, pine trees, ferns, and mosses. The kingdom Fungi has more than 100,000 known species. These species include fungi, such as mushrooms and bread molds, as well as the lichens. The kingdom Protista has more than 100,000 known species. This kingdom includes green, golden, brown, and red algae; ciliates; sporozoans; sarcodines; and flagellates. The kingdom Prokaryotae consists of bacteria, including blue-green algae or cyanobacteria. There are more than 10,000 known species in this kingdom.

Division, or *phylum,* is the second largest group. The kingdoms Protista, Fungi, and Plantae are classified into *divisions.* In the animal kingdom, the term *phylum* is used instead of division. Scientists disagree on which term should be used for the kingdom Prokaryotae.

The animal kingdom may be divided into 20 or more phyla. All animals with backbones belong to the phylum Chordata. The plant kingdom has 2 divisions. All plants that have flowers belong to the division Tracheophyta.

Class members have more characteristics in common than do members of a division or phylum. For example, mammals, reptiles, and birds all belong to the phylum Chordata. But each belongs to a different class. Apes, bears, and mice are in the class Mammalia. Mammals have hair on their bodies and feed milk to their young. Reptiles, including lizards, snakes, and turtles, make up the class Reptilia. Scales cover the bodies of all reptiles, and none of them feed milk to their young. Birds make up the class Aves. Feathers grow on their bodies, and they do not feed milk to their young.

Order consists of groups that are more alike than those in a class. In the class Mammalia, all the animals produce milk for their young. Dogs, moles, raccoons, and shrews are all mammals. But dogs and raccoons eat flesh, and are grouped together in the order Carnivora, with other flesh-eating animals. Moles and shrews eat insects, and are classified in the order Insectivora, with other insect-eating animals.

Family is made up of groups that are even more alike than those in the order. Wolves and cats are both in the

Plant kingdom

WORLD BOOK illustrations by John M. Bolt Jr. and Trudy Rogers

Kingdom
Plantae

Cattail, Fern, Larkspur, Sunflower, Common buttercup, Pine, Grass, Water crowfoot, Magnolia, Hornwort, Maple, Moss

Division
Tracheophyta

Plants that have (1) true stems, leaves, and roots

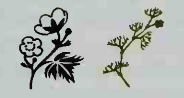
Class
Anthopsida

Plants that have (1) true stems, leaves, and roots and (2) flowers with reproductive organs called *ovaries* that protect *ovules* (structures that can develop into seeds)

Order
Ranales

Plants that have (1) true stems, leaves, and roots, (2) flowers that have ovaries, and (3) *floral parts* (petals, sepals, stamens) that grow from beneath the ovary

Family
Ranunculacae



Plants that have (1) true stems, leaves, and roots, (2) flowers that have ovaries, (3) floral parts growing from beneath the ovary, and (4) many spirally arranged stamens

Genus
Ranunculus



Plants that have (1) true stems, leaves, and roots, (2) flowers that have ovaries, (3) floral parts growing from beneath the ovary, (4) many spirally arranged stamens, and (5) all petals identical

Species
Ranunculus acris

Plants that have (1) true stems, leaves, and roots, (2) flowers that have ovaries, (3) floral parts growing from beneath the ovary, (4) many spirally arranged stamens, (5) all petals identical, and (6) yellow flowers

order Carnivora. But wolves are in the family Canidae. All members of this family have long snouts and bushy tails. Cats belong to the family Felidae. Members of this family have short snouts and short-haired tails.

Genus consists of very similar groups, but members of different groups usually cannot breed with one another. Both the coyote and the timber wolf are in the genus *Canis*. But coyotes and timber wolves generally do not breed with one another.

Species is the basic unit of scientific classification. Members of a species have many common characteristics, but they differ from all other forms of life in one or more ways. Members of a species can breed with one another, and the young grow up to look very much like the parents. No two species in a genus have the same scientific name. The coyote is *Canis latrans,* and the gray wolf is *Canis lupus*. Sometimes groups within a species differ enough from other groups in the species that they are called *subspecies* or *varieties*.

Development of classification. For thousands of years, people have tried to classify living things. Early human beings divided all organisms into two groups: (1) useful, and (2) harmful. As people began to recognize more kinds of living things, they developed new ways to classify them. One of the most useful was suggested by the Greek philosopher and naturalist Aristotle, who lived during the 300's B.C. Only about a thousand organisms were known in his time. He classified animals as those with red blood—animals with backbones—and those with no red blood—animals without backbones. He divided plants by size and appearance as herbs, shrubs, or trees. Aristotle's scheme served as the basis for classification for almost 2,000 years.

During the 1600's, the English biologist John Ray first suggested the idea of species in classification. But the basic design for modern classification began with the work of the Swedish naturalist Carolus Linnaeus in the 1700's. Linnaeus classified organisms according to their structure and gave distinctive two-word names to each species. Many of Linnaeus's groupings from species through orders still are accepted today. But his higher groupings often were based on superficial physical resemblances. Modern classifications are based on more microscopic structural and biochemical characteristics, as well as on presumed evolutionary relationships among the organisms. Classifications continue to change as more information becomes available.

Theodore J. Crovello

Related articles in *World Book* include:

Animal (table: A classification)	Kingdom
Botany	Linnaeus, Carolus
Flower (How flowers are named and classified; table: Representative families of flowers)	Order
	Plant (table: A classification of the plant kingdom)
	Prokaryote
Fungi	Protist

Additional resources

Anderson, Margaret J. *Carl Linnaeus: Father of Classification*. Enslow, 1997. Younger readers.

Minelli, Alessandro. *Biological Systematics*. Chapman & Hall, 1993.

Quicke, Donald L. J. *Principles and Techniques of Contemporary Taxonomy*. Blackie Academic, 1993.

Ritvo, Harriet. *The Platypus and the Mermaid and Other Figments of the Classifying Imagination*. Harvard Univ. Pr., 1997.

Claude (1600-1682) was a French painter who established a tradition of landscape painting that influenced artists in Europe and America for 200 years. Claude's full name was Claude Gellée, but he is often called Claude Lorrain, after his native province of Lorraine. Claude settled in Rome in 1627 and lived there the rest of his life.

Claude's landscapes show the Italian countryside bathed in golden light. They have a feeling of calm and peace, sometimes tinged with sadness. Peasants and their farm animals appear in some of his paintings. In others, characters from mythology contribute to the mood. Claude also painted seaport or river scenes with the setting sun reflected in the water.

Like other artists of his time, Claude went into the countryside to make sketches but completed his paintings in his studio. Patrons would have been insulted to receive a mere copy of nature that the artist had not bothered to idealize. Claude's landscapes were immediately popular and continued to be influential for generations. His work was especially popular in England in the 1700's. There it influenced garden design and helped shape the style of the great English landscape painter J. M. W. Turner. Ann Friedman

See also **Classicism** (picture).

Claudel, *kloh DEHL,* **Paul** (1868-1955), was a French writer and diplomat. He became one of the foremost French poets and playwrights in the early 1900's and helped provide a new religious focus to the literature of his time. His writings are examples of the Roman Catholic revival in French literature and philosophy.

Early in his life, Claudel lost his religious faith. But on Christmas Day in 1886, he had a spiritual experience while listening to evening prayers in the Cathedral of Notre Dame in Paris. This experience led to the return of his faith and to his acceptance of orthodox Catholicism.

Claudel expresses his religious faith in such lyric poems as *Cinq Grandes Odes* (1910). But he is best known as a playwright. His most famous play, *The Tidings Brought to Mary* (1912), portrays the triumph of divine love. It illustrates themes common throughout his work: the relationship between human love and salvation, the link between humanity and divine will, and the necessity of self-sacrifice for the redemption of others.

Claudel was born in Villeneuve-sur-Fère, near Soissons, France. Between 1893 and 1935, he worked in several countries as a French diplomat. He served as France's ambassador to Japan, the United States, and Belgium. Claudel was elected to the French Academy in 1946. Dora E. Polachek

See also **French literature** (The four masters).

Claudius (10 B.C.-A.D. 54) was the emperor of Rome from A.D. 41 to 54. Claudius was a capable but eccentric ruler. He built aqueducts, drained marshes, and made a harbor near Ostia at the mouth of the Tiber River. However, he became unpopular for executing senators and for giving secretaries who had been slaves great influence. He ordered the conquest of Britain that began in A.D. 43 and made the Balkan Peninsula (then called Thrace) a Roman province in A.D. 46. He also granted citizenship to many people from Rome's provinces.

Claudius was born in Lugdunum (now Lyon), France. His full name was Tiberius Claudius Nero. Lame and a stutterer, Claudius was kept from public view in his youth. He spent his time studying and writing histories

of Etruria and Carthage. Claudius married several times. After he married his niece Agrippina the Younger, he adopted her son Nero. It is generally believed that Agrippina murdered Claudius so that Nero could become emperor (see **Nero**). F. G. B. Millar

Clause is a group of words with a subject and a predicate. A *main,* or *independent,* clause can stand alone as a complete sentence. For example, "We were practicing" is both a main clause and a sentence. A *subordinate,* or *dependent,* clause cannot stand alone and functions as (1) a noun, (2) an adjective, or (3) an adverb. Each kind of subordinate clause typically begins with a particular kind of word.

Noun clauses often begin with the word *that.* In the sentence "They knew that we were practicing," the noun clause is *that we were practicing.* The clause serves the noun function of being the direct object in the sentence. Sometimes the beginning word can be deleted: "They knew we were practicing." But *we were practicing* is still a noun clause. A noun clause may serve other noun functions. In "That we were practicing was obvious to everyone," the clause *that we were practicing* is the subject of the sentence.

An adjective clause is commonly known as a *relative clause.* It usually begins with a relative pronoun, and it modifies a noun. In the sentence "The musicians who were practicing sounded marvelous," the relative clause is *who were practicing.* It begins with the relative pronoun *who* and modifies the noun phrase *the musicians.* Other words that are often used as relative pronouns are *that, which, whom,* and *whose.*

Adverb clauses begin with subordinating adverbial conjunctions and act as adverbs. Frequently used subordinating adverbial conjunctions include *after, when, while, where, wherever,* and *because.* Adverbs often tell when, where, or why an action occurred. In "While we were practicing, they listened," the adverb clause *while we were practicing* performs the adverbial function of telling *when* they listened. Sara Garnes

Clausewitz, *KLOW zuh vihts,* **Karl von** (1780-1831), was a Prussian army officer and military theorist. His theories and observations about war, published in the book *On War* (1832-1834), influenced military strategy for more than 100 years.

Clausewitz was born in Burg, Prussia. He joined the army in 1792 and fought in numerous battles against the French armies of Emperor Napoleon I. These battles included the campaign of 1815, when Napoleon was finally defeated. In 1818, Clausewitz became director of the War College in Berlin.

In his writings, Clausewitz observed that armies of citizens fighting for their nation showed greater determination than professional soldiers fighting only for territory. Clausewitz' most original contribution was his analysis of the close relationship between the army and the nation. To Clausewitz, war was merely "the pursuit of diplomacy by other means." Thus, it was necessary to consider the political interests of the nation as more important than military goals. He also stressed that a nation at war must take risks and act boldly to obtain a decisive and total victory. Charles W. Ingrao

Clausius, *KLOW zee uhs,* **Rudolf Julius Emmanuel** (1822-1888), a German physicist, helped establish thermodynamics as a science. In 1850, he stated the second law of thermodynamics: "Heat cannot of itself pass from a colder to a hotter body" (see **Thermodynamics**). He derived an equation that relates the saturated vapor pressure of a liquid to the temperature. He also developed a theory to explain electrolysis (see **Electrolysis**). Clausius was born in Köslin, Germany (now Koszalin, Poland). Richard G. Olson

Claustrophobia. See **Phobia.**

Clavichord, *KLAV uh kawrd,* is a keyboard musical instrument that was a forerunner of the piano. The clavichord's tone is produced by metal blades that strike the instrument's wire strings when keys are pressed down. The blades, called *tangents,* remain in contact with the strings as long as the keys are held down. This action allows the player to control the tone after the first attack by making slight changes in pitch. This is an important feature of the instrument. The word *clavichord* comes from the Latin words *clavis,* which means *key,* and *chorda,* which means *string.*

The clavichord dates from the 1400's. It produces soft tones, and so it was used for musical practices and entertaining small gatherings instead of for playing in public concerts. The instrument became especially popular in Germany. During the 1700's, the piano was developed and began to replace the clavichord. F. E. Kirby

See also **Piano** (History).

Clavicle. See **Collarbone.**

Claw. See **Animal** (How animals protect themselves; picture).

Clay is a substance present in most kinds of soil. Geologists define clay as extremely small particles of soil that measure less than 4 microns, or 0.000157 inch, in diameter. The word *clay* also refers to earthy material composed of certain kinds of silicate minerals that have been broken down by weathering.

Clay consists mainly of tiny, sheetlike particles of alumina and silica bound together by water. Various other materials in clay may give it different colors. For exam-



WORLD BOOK photo by Ralph Brunke

An artist uses clay to model an earthenware vase. Sculptures, dishes, and other objects may also be created from clay.

ple, iron oxide may color clay red. Clays that contain various amounts of carbon compounds may be different shades of gray.

The clay in soil has a vital role in farming. For example, it absorbs ammonia and other gases needed for plant growth. Clay also helps soil retain minerals necessary for plant growth. Without clay, soil would not keep its fertility from year to year. However, too much clay makes soil stiff and heavy and prevents the movement of air and water through soil.

There are two general types of clay, based on how the substance reacts when mixed with water. *Expandable clay* swells when water is added to it. Expandable clay can absorb so much water that the clay itself becomes a liquid. *Nonexpandable clay* becomes soft but not liquid when mixed with water.

The petroleum industry uses expandable clays called *bentonites* to make drilling mud. The petroleum industry also uses another kind of expandable clay as a chemical agent in the process of oil refining.

Ceramics industries use nonexpandable clay in making bricks, pottery, tile, and many other products. For example, pottery makers mold moist clay into almost any shape and bake it in hot ovens called *kilns*. Heat removes the water from the clay, which becomes permanently hard and cannot be softened by adding water to it. The whitest kind of clay, *kaolin* or *china clay,* is used in making porcelain. The paper industry also uses kaolin, which serves as a filler that adds whiteness and strength to paper. In addition, kaolin gives some kinds of paper a smooth, shiny surface. *Fire clay* contains a large percentage of silica and can stand high temperatures. It is used in making firebrick and furnace linings.

Taylor J. Johnston

Related articles in *World Book* include:

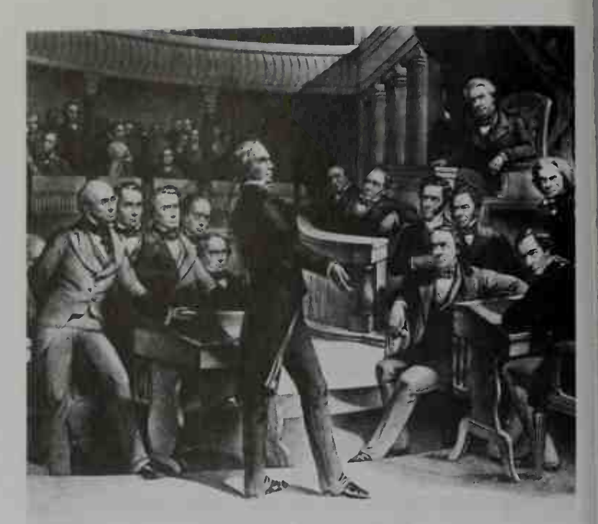
Alumina	Kaolin	Silica
Brick	Loam	Soil
Ceramics	Porcelain	Terra cotta
Feldspar	Pottery	Tile
Fuller's earth		

Clay, Cassius. See Ali, Muhammad.

Clay, Cassius Marcellus (1810-1903), was an American politician and abolitionist. He was the son of a slaveholder, but he learned to despise slavery and preached against it. In 1845, he founded an antislavery newspaper, *True American,* in Lexington, Kentucky. After moving to Louisville, he called it the *Examiner.* His views on slavery and his fiery nature earned him a reputation as a rebel and a fighter. He carried two pistols and a knife because of threats on his life, and he guarded his office and his home with a cannon.

Clay was born in Madison County, Kentucky, and studied at Yale. He served in the Kentucky legislature in 1835, 1837, and 1840. He worked for Abraham Lincoln's election in 1860 and was minister to Russia in 1861 and 1862 and from 1863 to 1869. James M. McPherson

Clay, Henry (1777-1852), was a leading American statesman for nearly 50 years. Clay became known as the Great Compromiser because he repeatedly helped settle bitter disputes over slavery between the Northern and Southern states. His compromises did much to hold the nation together during the first half of the 1800's. Clay's charm, generosity, and eloquent speeches made him one of the most idolized figures of his time.



Engraving by R. Whitechurch; Library of Congress, Washington, D.C.

Henry Clay spoke eloquently before the United States Senate in support of the Compromise of 1850, *shown here.* His ability to bring about compromises between the North and the South earned him the title the Great Compromiser.

Clay served as speaker of the U.S. House of Representatives, a U.S. senator, and a U.S. secretary of state. He campaigned for president unsuccessfully five times. Through the years, Clay showed great devotion to principle. Once, after taking a controversial stand on slavery, he said, "I had rather be right than be president."

Early career. Clay, the son of a Baptist minister, was born on April 12, 1777, in Hanover County, Virginia. He received little formal schooling but had a sharp mind and liked to read. Clay studied law and, at the age of 20, set up a successful law practice in Lexington, Kentucky.

In 1803, Clay was elected to Kentucky's state legislature. The legislature greatly admired Clay and elected him to fill an unexpired term in the U.S. Senate in 1806. At that time, state legislatures elected U.S. senators. Clay was not quite 30 years old, the minimum age required by the Constitution of the United States. However, the Senate did not investigate Clay's age. In 1810 and 1811, Clay filled another unexpired term in the U.S. Senate.

National leader. Clay was elected to the U.S. House of Representatives in 1811. He had become known as an outstanding leader and was chosen speaker of the House on the first day of the session. Clay was reelected to the House and to the office of speaker five more times. He became head of the "War Hawks," a group that helped influence Congress to declare war against the United Kingdom in 1812. But Clay also helped negotiate peace with the British and was a signer of the Treaty of Ghent. See War of 1812.

After the war, Clay proposed a national economic plan called "the American System." The plan included a protective tariff to aid American manufacturers, a national bank, and government support of improvements in transportation. Clay became the most important leader of the National Republican Party, which endorsed his economic program.

The Missouri Compromise. In 1820, Clay helped settle a dispute between the North and South over the expansion of slavery. He helped win congressional ap-

proval of a plan that became known as the Missouri Compromise. The compromise permitted slavery in the new state of Missouri and banned it in the new state of Maine. The compromise also prohibited slavery in most of the Louisiana Territory, a huge area west of the Mississippi River. See **Missouri Compromise.**

Clay also played a key role in settling a dispute over the federal tariff. The dispute arose in 1832, when South Carolina *nullified* (declared unconstitutional) two U.S. tariff laws. South Carolina threatened to *secede* (withdraw) from the United States if the federal government tried to enforce the tariff in the state. But in 1833, Clay persuaded Congress to pass a compromise bill to gradually lower the tariff. His measure helped preserve the supremacy of the federal government over the states.

Candidate for president. Clay ran for the presidency five times, but never won. In the presidential election of 1824, Clay's first attempt, no candidate received a majority of the votes in the Electoral College. As a result, the U.S. House of Representatives had to choose the president from among the three candidates who received the most electoral votes. Clay had come in fourth in the voting, behind Andrew Jackson, John Quincy Adams, and William H. Crawford. He gave his support to Adams, who was then elected president. Clay served as Adams's secretary of state from 1825 to 1829.

In 1832, Clay ran as the candidate of the National Republican Party. He opposed President Andrew Jackson, the Democratic-Republican candidate. Jackson won easily, partly because Clay supported efforts to renew the charter of the unpopular Bank of the United States. Clay and other National Republicans helped form the Whig Party in 1834. Clay ran for president again in 1840 as a Whig, but he dropped out of the race when the Whig Party made William Henry Harrison its nominee.

Clay became the Whig Party's presidential candidate in 1844. He opposed James K. Polk of the Democratic Party. Annexation of the then-independent Republic of Texas became a major campaign issue. Clay opposed annexation and warned that it would provoke war with Mexico and reawaken the controversy over slavery in the United States. Polk favored annexation and narrowly won the election. Later, Clay's warnings came true. A border dispute led to the Mexican War (1846-1848), and the North and South later clashed over the question of extending slavery into the territory gained from the war. Clay sought the presidency again in 1848. He ended his campaign when the Whigs nominated Zachary Taylor, a general who had become a hero in the Mexican War.

The Compromise of 1850. Clay retired to Ashland, his plantation in Lexington, in 1848. In 1849, the Kentucky legislature again elected him to the U.S. Senate. Clay helped settle another dispute between Northern free states and Southern slave states, sponsoring a plan known as the Compromise of 1850. Parts of this plan allowed slavery in the New Mexico and Utah territories and prohibited it in California. The Compromise of 1850 helped delay the American Civil War for 11 years. See **Compromise of 1850.**

Personal life. In 1799, Clay married Lucretia Hart, the daughter of a wealthy Lexington land speculator and merchant. The Clays suffered several tragedies in their home life. Their oldest son, Theodore, was confined to a mental institution. Their six daughters died young, and their son Henry was killed during the Mexican War.

Clay died in Washington, D.C., in June 1852 and was buried in Lexington. A marker by his grave has a quotation from one of his speeches: "I know no North—no South—no East—no West." Daniel Walker Howe

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Clay, Lucius Dubignon (1897-1978), served as commander in chief of the United States armed forces in Europe and as military governor of the U.S. zone in Germany from 1947 to 1949. In 1948, the Soviet Union blockaded all supply routes to the Western section of Berlin, hoping to drive out of Berlin the forces of the United States, the United Kingdom, and France. But the Berlin Airlift, directed by Clay, flew food and other supplies into the city.

Clay was born on April 23, 1897, in Marietta, Georgia, and graduated from the United States Military Academy in 1918. He served as an Army engineer. During World War II, Clay directed the delivery of supplies to invasion fronts. He retired from the Army in 1949, and became associated with several civilian firms.

Clay served as an adviser to the Office of Defense Mobilization in 1951. In 1961 and 1962, he served as the personal representative of President John F. Kennedy in Germany. From 1968 to 1974, Clay was chairman of Radio Free Europe. He wrote a book, *Decision in Germany* (1950), based on his experiences in military government.

James J. Sheehan

Clayton, John Middleton (1796-1856), was an American political leader. He served as United States secretary of state in 1849 and 1850, under President Zachary Taylor. As secretary of state, he negotiated the Clayton-Bulwer Treaty of 1850. In this pact, the United States and the United Kingdom agreed to protect the neutrality of a canal to be built through Central America. The treaty helped the two countries avoid war over the proposed canal. See **Clayton-Bulwer Treaty.**

Clayton was born on July 24, 1796, in Dagsboro, Delaware. He served as chief justice of Delaware from 1837 to 1839 and represented Delaware in the U.S. Senate from 1829 to 1836, 1845 to 1849, and 1853 to 1856. For most of his career, Clayton belonged to the Whig Party. A statue of him represents Delaware in the U.S. Capitol.

Michael F. Holt

Clayton Antitrust Act. See **Antitrust laws.**

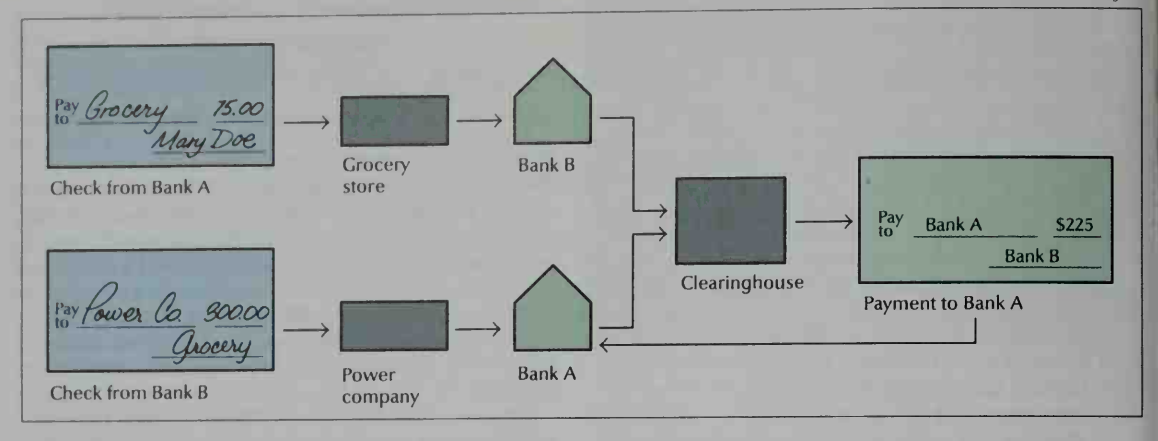
Clayton-Bulwer Treaty, signed by the United States and the United Kingdom in 1850, gave both countries an equal share in the protection of a canal to be built through Central America. Both countries agreed to maintain the neutrality of the canal and the land on either side of it. The treaty was named for John M. Clayton, American secretary of state, and Sir Henry Bulwer, British minister to the United States. It became unpopular in the United States. In 1901, the Hay-Pauncefote Treaty replaced the Clayton-Bulwer Treaty. It granted the United States the right to build and manage the canal. See also **Hay-Pauncefote Treaty.** Robert F. Dalzell, Jr.

Clearinghouse is an institution used by banks to exchange checks and to establish claims against each

How a clearinghouse works

A clearinghouse is an institution used by banks to settle their debts with one another. For example, suppose Bank B has a check for $75 from a customer of Bank A, and Bank A has a check for $300 from a customer of Bank B. Instead of paying the checks separately, the banks send them to a clearinghouse. It would find that both debts could be settled at once if Bank B paid $225 to Bank A.

WORLD BOOK diagram



other that result from financial transactions. Clearinghouses may be formal institutions with written rules and regulations, or they may consist of informal arrangements among banks. Nearly every city in the United States with more than two banks has a clearinghouse operated by an association of local banks. Formal clearinghouses operate in most large U.S. cities. Banks collect most checks drawn on out-of-town banks through Federal Reserve Banks or through commercial banks called *correspondent banks.* The rest of these checks are exchanged directly with banks in other cities.

A clearinghouse allows banks to settle debts with one another with the smallest possible exchange of funds. Suppose you have a checking account at Bank A and write a check for $75 at a grocery store. The store deposits the check in its account at Bank B. The grocery store then sends a check for $300 to the power company, which deposits the check in its account at Bank A. The banks send both checks to the local clearinghouse.

The clearinghouse would examine the checks and find that Bank A owes $75 to Bank B, and Bank B owes $300 to Bank A. Both debts could be settled at once if Bank B paid $225 to Bank A. Actually, a clearinghouse may handle thousands or millions of checks and other transactions daily. The dollar amounts tend to offset each other, leaving much smaller amounts to be transferred between the banks.

Almost all U.S. banks that use a formal clearinghouse have an account at their district Federal Reserve Bank. The clearinghouse gives the Federal Reserve Bank information that allows settlement between banks through their Federal Reserve accounts. In some cases, banks that use a particular clearinghouse settle claims against each other through accounts at one of the user banks.

The first clearinghouse was formed in London in the late 1700's. In 1853, New York City banks formed the first U.S. clearinghouse. In 1970, the Clearing House Interbank Payments System (CHIPS) began operating in New York City. This system handles electronic fund transfers that are related to international financial transactions. Its computer network provides settlement information to the Federal Reserve Bank of New York. Joanna H. Frodin

Cleary, Beverly (1916-), is an American author of books for children. She is best known for her series of books about the adventures of two youngsters named Henry Huggins and Ramona Quimby. The two characters and their friends live in a middle-class suburb of Portland, Oregon. Cleary's books are noted for their humor and for their realistic and natural dialogue.

Cleary's first book was *Henry Huggins* (1950). Ramona first appeared as a major character in *Beezus and Ramona* (1955). Cleary's other children's books include *Ellen Tebbits* (1951), *The Mouse and the Motorcycle* (1965), and *Runaway Ralph* (1970). Cleary was born in McMinnville, Oregon. In 1975, she received the Laura Ingalls Wilder Award for her contributions to children's literature. Cleary won the 1984 Newbery Medal for *Dear Mr. Henshaw* (1983). She wrote two autobiographies, *A Girl from Yamhill* (1988) and *My Own Two Feet* (1995).

Marilyn Fain Apseloff

Cleaver, Eldridge (1935-1998), became known for preaching the doctrine of *Black Power.* According to this doctrine, blacks must organize politically so they can deal with white society from a position of strength. Cleaver became best known for his book *Soul on Ice* (1968). Critics praised the book's insights into black attitudes toward American society.

Leroy Eldridge Cleaver was born in Wabbaseka, Arkansas, and grew up in California. As a youth, he spent several years in prison. In 1958, he was convicted of assault with intent to kill and given a 2- to 14-year sentence. He was paroled in 1966 and joined the Black Panther Party (see **Black Panther Party**).

In 1968, Cleaver ran as the United States presidential candidate of the Peace and Freedom Party. Later that year, he fled to Algeria after he became involved in a shooting incident. Cleaver returned to the United States in 1975. He said he had experienced a "religious conversion" and gave up many of his earlier political beliefs. He described his conversion in his book *Soul on Fire* (1978). Cleaver then was arrested for parole violation. He was released on probation in 1980. In 1986, Cleaver sought the Republican nomination for the United States Senate in California but was not successful. Hanes Walton, Jr.



© Hulton Getty from Liaison Agency

John Cleese, *far left*, was a member of an English comedy team called Monty Python. Other members, *from left to right*, included Michael Palin, Eric Idle, and Graham Chapman.

Cleese, John (1939-), is an English actor and writer internationally known for his distinctive style of physical and verbal comedy. Cleese first gained recognition as part of a gifted and zany group of young English comic actors who starred in a television review called "Monty Python's Flying Circus." The program's unique blend of satire and broad comedy made it a cult favorite, especially through reruns after the show ceased production. Cleese also won fame as Basil Fawlty, the frenzied operator of an English resort hotel in the English TV series "Fawlty Towers" (1975-1979).

John Marwood Cleese was born on Oct. 27, 1939, in Weston-super-Mare, England, near Bristol. He received a master's degree in law from Cambridge University but decided to go into show business. He started as a comedy writer and comedian and then began appearing on English television. He gained international popularity for "Monty Python's Flying Circus" along with Terry Gilliam, Terry Jones, Graham Chapman, Eric Idle, and Michael Palin. Cleese and other Monty Python members co-starred in a number of motion pictures made by the group, including *And Now for Something Completely Different* (1971), *Monty Python and the Holy Grail* (1975), *Monty Python's Life of Brian* (1979), *Monty Python Live at the Hollywood Bowl* (1982), and *Monty Python's The Meaning of Life* (1983)

Cleese's other films include *Time Bandits* (1981), *Clockwise* (1986), *A Fish Called Wanda* (1988, which he also wrote), *The Jungle Book* (1994), and *Fierce Creatures* (1996). Cleese is also the coauthor of the books *Monty Python's Big Red Book* (1971), *The Strange Case of the End of Civilization As We Know It* (1977), *Families and How to Survive Them* (1983), and *Life and How to Survive It* (1989). Dan Zeff

Cleft lip. See Cleft palate.

Cleft palate, *PAL iht,* is a birth defect in which there is a split in the roof of the mouth. Many people born with a cleft palate also have a *cleft lip*—a split through the upper lip. Cleft lip—with or without cleft palate—occurs in about 1 out of every 700 births. Cleft palate alone occurs in about 1 out of every 2,500 births.

Clefts result when the tissues that form the roof of the mouth or the lip fail to unite in the unborn baby. Research indicates that this may be caused by a combination of environmental and hereditary factors.

A cleft palate starts at the rear of the mouth. In some cases, it involves only the *soft palate*—the muscular tissue that forms the rear part of the roof of the mouth. In other cases, it extends into the *hard palate*—the bony tissue that makes up the front part of the mouth's roof. It may even extend through the gum.

Speech defects are one of the chief problems caused by a cleft palate. During normal speech, the soft palate rises to separate the mouth and nasal cavities. Such separation cannot be attained with a cleft palate, and certain sounds cannot be formed properly. Another serious problem is chronic ear infections. These result if the cleft palate interferes with the drainage of fluids through the *Eustachian tube*. This tube connects the middle ear with the back of the throat.

A cleft in the lip can be *complete* (extending into the nostril) or *partial* (stopping before the nostril). A cleft lip is sometimes called a *harelip* because it resembles the split lip of a hare. By itself, a cleft lip is chiefly a defect in appearance.

Cleft palates and lips can be repaired by surgically joining the split structures. Surgical repair of a cleft lip often produces almost normal appearance. Repair of a cleft palate greatly improves speech ability. However, some patients require speech therapy, additional surgery, or both to obtain usable speech. If clefts extend into the gum, orthodontia may be needed to correct the angle of the teeth. David W. Furnas

Cleisthenes, *KLYS thuh neez,* was a statesman in ancient Athens. He established a democratic constitution there after Hippias, who held complete political power, was overthrown in 510 B.C. Cleisthenes was the head of the noble Alcmaeonid clan. This clan had an *oracle* (prophet) persuade Cleomenes, the king of Sparta, to overthrow Hippias. After that, Cleisthenes gained public support and set up a democratic form of government. He then reformed the Athenian tribal organization, ending the political control of the noble clans. The government had a council of 500 members who were chosen each year in a drawing. Membership in the council was open to any citizen. Some scholars believe that to protect the new democracy, Cleisthenes enacted a law providing for *ostracism* (banishment) of politicians the people thought were dangerous. Donald Kagan

See also **Athens** (History).

Clematis, *KLEHM uh tihs* or *klih MAT ihs,* is any one of a group of perennial herbs or woody vines that grow in North America, Europe, and Asia. Several small-flowered kinds are called *virgin's-bower*. The most popular American species include a large group of hybrid varieties. These vines may climb 10 feet (3 meters) high and have flowers 6 inches (15 centimeters) wide. The flowers may be blue, violet, white, pink, or red. After the flowers fade, the plant bears small dry fruits. The fruits often have long feathery tufts attached. Melinda F. Denton

Scientific classification. Clematis is in the crowfoot family,

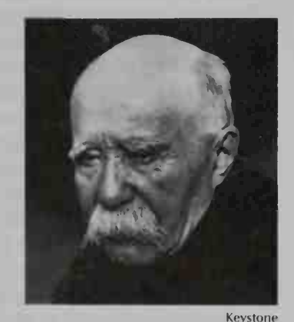


WORLD BOOK illustration by Robert Hynes

An American clematis, *shown here,* has violet blossoms that grow in clusters.

Ranunculaceae. The scientific name for the best-known American vine is *Clematis jackmanii.*

Clemenceau, *KLEHM uhn SOH* or *kleh mahn SOH,* **Georges,** *zhawrzh* (1841-1929), a French statesman, led France triumphantly through the last and most difficult period of World War I. In 1917, at age 76, he became premier of France for the second time. He exercised powerful leadership with his slogan, "I make war!" and became known as "The Tiger of France." He presided over the Paris Peace Conference, where he insisted on severe terms for Germany and sought to protect France by creating an independent state out of German territory west of the Rhine River. Clemenceau ran for president of France in 1920 but lost to Paul Deschanel. He resigned as premier the day after his defeat.



Keystone

Georges Clemenceau

Clemenceau was born on Sept. 28, 1841, in Mouilleron-en-Pareds, near La Roche-sur-Yon, France. Trained as a doctor, he traveled and taught for a time in the United States, where he married an American. Clemenceau later became mayor of Montmartre, a section of Paris. He helped defend Paris against the Germans in 1870. Clemenceau served as a deputy from 1876 to 1893 and as premier from 1906 to 1909. Marc Trachtenberg

Clemens, Roger (1962-), ranks among the most dominating pitchers in American baseball history. Clemens became known for his overpowering fast ball, which earned him the nickname "Rocket Roger."

Clemens won the American League Cy Young Award as the league's best pitcher in 1986, 1987, and 1991 with the Boston Red Sox; in 1997 and 1998 with the Toronto Blue Jays; and in 2001 with the New York Yankees. He became the first major league pitcher to win the award six times. Clemens led the American League in strikeouts five times and in earned run average six times. He won 24 games in 1986 and was named the American League's Most Valuable Player. Clemens holds the American League record with 20 consecutive pitching victories, set in 1998 and 1999. He also holds the American League record for most career strikeouts.

William Roger Clemens was born on Aug. 4, 1962, in Dayton, Ohio. When he was a child, his family moved to Texas. Clemens was offered a contract with the Minnesota Twins after high school but chose to continue his education. After spending a year at San Jacinto Junior College, he transferred to the University of Texas. He was a star pitcher for the university, winning the College World Series championship game in 1983. Boston drafted him that year. After pitching in the minor leagues, Clemens joined the Red Sox in 1984. He signed with Toronto as a free agent after the 1996 season. In 1999, Clemens was traded to the Yankees. Dave Nightingale

Clemens, Samuel Langhorne. See Twain, Mark.

Clement I, Saint (? - about A.D. 101), was elected pope about A.D. 92. He is traditionally regarded as the third in succession to Saint Peter as bishop of Rome. Clement is most famous for a letter he wrote to the church in Corinth, probably in A.D. 96. The letter strongly condemned pride and arrogance within the church and clarified the order of succession from bishop to *presbyter* (elder) to *deacon* (assistant). In later years, Clement's letter was regarded as the first exercise of papal authority in the affairs of a Christian church outside Rome. But Clement's concerns in writing the letter were spiritual and fraternal, not legal. The letter is the oldest surviving Christian text except for the Scriptures.

Clement was a citizen of Rome. He may have been the Clement who worked with Saint Paul at Philippi. Many legends surround Clement's life. According to one, he was martyred by being thrown into the sea with an anchor tied to his neck. None of the legends can be verified. His feast day is November 23. Thomas F. X. Noble

Clement VII (1342-1394) was an *antipope*—that is, a man determined to have improperly claimed to be or served as pope. His reign began in 1378 and started a period in church history known as the Great Schism. See Roman Catholic Church (The Great Schism).

Clement was born in Geneva (now Geneva, Switzerland) and was known as Robert of Geneva before being elected pope. Pope Gregory XI made him a cardinal in 1371. Gregory sent Robert to Italy to make arrangements for the return of the pope to Rome after the long papal residence in Avignon, in what is now France. Gregory died in 1378, shortly after returning to Rome. Robert and the other cardinals elected a new pope in April 1378 who took the name Urban VI. Urban had an unstable personality and soon antagonized many cardinals. The French cardinals claimed Urban's election was illegal because they argued it had been held under threat of violence. They withdrew their allegiance and elected Robert pope in September 1378.

Many European countries recognized Clement as the true pope. However, the church now considers Urban VI and his successor, Boniface IX, as the legitimate popes during Clement's reign. Kenneth Pennington

Clement VII (1478-1534) was elected pope in 1523 and reigned during a stormy period in European religious

and political affairs. Clement was born on May 26, 1478, in Florence, Italy. His given and family name was Giulio de' Medici. His cousin, Pope Leo X, made him a cardinal in 1513. The Medici were a powerful family in Florence and after his election, Clement determined to preserve his family's control of the city. This control was threatened by struggles between the Holy Roman Empire and France for dominance in Italy. Clement shifted sides repeatedly. This policy proved disastrous when the forces of Holy Roman Emperor Charles V captured King Francis I of France in 1525. They raided Rome in 1527, forcing the pope to take refuge in the Castel Sant'Angelo.

Clement's concentration on Italian politics interfered with any effective papal response to the emerging Protestant Reformation. Lutheranism spread in Germany and was winning over Scandinavia. Clement's weak handling of the *annulment* (cancellation) of the marriage of King Henry VIII of England led to the split from Rome by the English church and the start of the Reformation in England. Charles L. Stinger

Clement VIII (1536-1605) was elected pope in 1592, during the time of renewal and reform in the Roman Catholic Church known as the Counter Reformation. As pope, Clement typified the spiritual ideals of Catholic reform. A pious man, he fasted rigorously, practiced extensive devotions, and regularly visited on foot the pilgrimage churches of Rome. He issued a corrected edition of the Vulgate Bible and also revised the main church liturgical books. In 1595, Clement recognized Henry of Navarre, a convert from Protestantism, as King Henry IV of France. Clement presided over the Jubilee of 1600, which attracted millions of pilgrims to Rome.

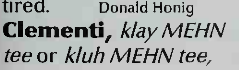
Clement was born on Feb. 24, 1536, in Fano, Italy. His given and family name was Ippolito Aldobrandini. He studied law and held posts on several papal commissions. He became a cardinal in 1585. Charles L. Stinger

Clemente, *kluh MEHN tee,* **Roberto** (1934-1972), a Puerto Rican athlete, was one of the greatest baseball players in history. He won four National League batting titles and had a lifetime batting average of .317. Clemente won the league's Most Valuable Player award in 1966.

Clemente, who played right field for the Pittsburgh Pirates, won fame for his fielding, throwing, and hitting. He helped lead the Pirates to World Series victories in 1960 and 1971. Clemente never went hitless in a World Series game. He was named the outstanding player of the 1971 series. On Sept. 30, 1972, three months before his death, he became the 11th man in major league history to get 3,000 hits.

Roberto Walker Clemente was born Aug. 18, 1934, in Carolina, Puerto Rico. He died in a plane crash near Puerto Rico while flying to aid earthquake victims in Nicaragua. Clemente was elected to the National Baseball Hall of Fame in 1973 in a special election, without the traditional waiting period of five years after a player has retired. Donald Honig


Wide World
Roberto Clemente



Clementi, *klay MEHN tee* or *kluh MEHN tee,* **Muzio,** *MOO tsyoh* (1752-1832), was an Italian composer best known for his piano music. Clementi was also a successful pianist, conductor, and manufacturer of pianos. His *Gradus ad Parnassum* (1817-1826) is a significant collection of 100 piano studies still used by students to develop their technique. Clementi's works also include more than 60 sonatas for piano or harpsichord, and about 40 sonatas for piano and other instruments. His compositions helped establish techniques for playing the piano, which was replacing the harpsichord as the most important keyboard instrument in the late 1700's.

Clementi was born on Jan. 23, 1752, in Rome. At the age of 14, he was taken to England to study music. In 1773, he made his London debut as a pianist and composer. In 1780 and 1781, he toured Europe as a piano soloist. He performed in a piano contest against Wolfgang Amadeus Mozart in 1781 at the court of the Holy Roman Emperor Joseph II. Clementi lived in England from 1810 until his death. Daniel T. Politoske

Cleopatra, *KLEE oh PAT ruh* or *KLEE oh PAY truh* (69-30 B.C.), was a queen of ancient Egypt and one of the most fascinating women in history. She lacked beauty, but became known for her intelligence, charm, wit, and ambition. At times, Cleopatra was ruthless. However, she took a great interest in her subjects' welfare and won their affection. Cleopatra loved and developed loyal relationships with Julius Caesar and Mark Antony, two of the greatest Roman leaders of her day.

Cleopatra belonged to the *dynasty* (series of rulers in the same family) founded by Ptolemy I in 323 B.C. Ptolemy was a general in the army of the Macedonian conqueror Alexander the Great. Cleopatra is also known as Cleopatra VII because she was the seventh Egyptian queen of Macedonian descent with that name.

Cleopatra and Caesar. Cleopatra became the queen of Egypt in 51 B.C. after the death of her father, Ptolemy XII. Her 10-year-old brother, Ptolemy XIII, became her co-ruler and husband. Marriage between a brother and a sister was a common practice in Egyptian royal families.

In 48 B.C., young Ptolemy's guardians seized power for him and drove Cleopatra from the throne. At the same time, Julius Caesar arrived in Alexandria, Egypt's capital. He came in pursuit of Pompey, a Roman general and rival in Caesar's struggle to become the ruler of Rome. Caesar and Cleopatra met and fell in love.

Caesar defeated Cleopatra's opponents. Ptolemy XIII drowned while trying to escape. Caesar then put Cleopatra back on the throne along with another brother, Ptolemy XIV. In 47 B.C., Cleopatra gave birth to a boy, Ptolemy Caesar, who is also known as Caesarion. She claimed the child was Caesar's son. In 46 B.C., at Caesar's invitation, she went with Caesarion and Ptolemy XIV to Rome. She stayed there until 44 B.C., when a group of Roman aristocrats assassinated Caesar. After returning to Egypt, Cleopatra had her brother Ptolemy killed so that Caesarion could reign with her as Ptolemy XV.

Cleopatra and Mark Antony. In 41 B.C., Mark Antony invited Cleopatra to Tarsus in Asia Minor (now Turkey). Antony was then one of the rulers of Rome, with Gaius Octavian and Marcus Lepidus. Antony had met Cleopatra when she stayed in Rome as Caesar's guest. Antony wanted to rule Rome alone and hoped to obtain

financial aid from Cleopatra. Antony and Cleopatra fell in love. In 40 B.C., Cleopatra gave birth to twins, Alexander Helios and Cleopatra Selene. Antony loved Cleopatra and their children. But he left them to marry Octavia, the sister of his co-ruler Octavian (see **Octavia**). The marriage was a wise political move, but Antony missed Cleopatra. He left Octavia in 37 B.C., returned to Cleopatra, and soon married her. In 36 B.C., she had another son by him, Ptolemy Philadelphos.

Antony and Cleopatra worked closely to achieve their ambitions. He believed that the wealth of Egypt would help him become the sole ruler of Rome. She wished chiefly to put her children, especially Caesarion, in line to rule Rome. In 34 B.C. Antony appointed Cleopatra ruler of Egypt, Cyprus, Crete, and Syria. He gave his sons and daughter by Cleopatra much of the land once ruled by Alexander the Great. These actions angered Antony's co-rulers and rivals. Octavian regarded Cleopatra as greedy and ambitious, and felt that she had turned Antony into a helpless puppet.

In 32 B.C., Octavian and Antony went to war. In 31 B.C., forces of Antony and Cleopatra lost the Battle of Actium off the west coast of Greece (see **Actium, Battle of**). Cleopatra and Antony then returned to Alexandria. A few months later, Octavian came after them. In 30 B.C., after Octavian reached Egypt, Cleopatra spread a report that she had committed suicide. Antony heard the report and stabbed himself out of grief. Before he died, Antony learned that Cleopatra was alive. His followers carried him to Cleopatra, and he died in her arms.

Cleopatra believed that Octavian would publicly humiliate her in Rome. She tried to make peace with him, but failed. In despair, Cleopatra took her life by placing an asp, a poisonous snake, on her chest or arm. The Romans executed Caesarion because they feared he would claim to be Caesar's heir and the rightful ruler of Rome's empire. The deaths of Cleopatra and Caesarion ended the rule of the dynasty of the Ptolemies in Egypt.

Cleopatra's reputation in history comes largely from the views of Octavian, who described Antony as the lovestruck victim of a wicked temptress. The Roman poets Virgil and Horace also adopted this version. Cleopatra's story has been told many times in literature. It is dramatized in the famous plays *Antony and Cleopatra* (1607) by William Shakespeare, *All for Love* (1677) by John Dryden, and *Caesar and Cleopatra* (1901) by George Bernard Shaw. William G. Sinnigen

See also **Antony, Mark**; **Augustus**; **Caesar, Julius**; **Egypt, Ancient** (picture).

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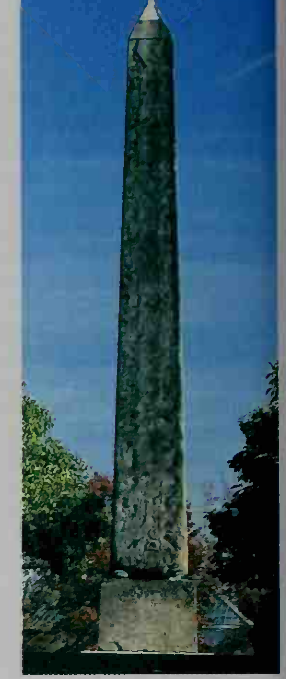
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Cleopatra's Needles, *KLEE oh PAT ruhs* or *KLEE oh PAY truhs,* are two famous *obelisks* (tall pillars of stone) from ancient Egypt. One stands in Central Park in New York City. The other stands along the River Thames in London. The obelisk in New York rises 69 feet (21 meters) and weighs 200 tons (180 metric tons). The one in London is 68 $\frac{1}{2}$ feet (20.9 meters) tall and weighs 180 tons (160 metric tons). Egypt gave the obelisks to the United States and the United Kingdom in the 1870's.

Kings of ancient Egypt erected such obelisks as Cleopatra's Needles as monuments to the sun god Re. The kings built the largest of these monuments at Memphis, Heliopolis, and Thebes between 1500 and 1200 B.C.

Cleopatra's Needles bear the name of Thutmose III, who ruled Egypt during the 1400's B.C. They also include markings added by Ramses II, an Egyptian ruler of the 1200's B.C. Cleopatra's Needles originally stood at the temple of Re at Heliopolis. About 10 B.C., the Roman rulers of Egypt moved them to Alexandria to decorate a palace. Scholars do not know why the obelisks became associated with Queen Cleopatra of Egypt.

Leonard H. Lesko



Cleopatra's Needle stands in Central Park in New York City. Egypt gave the 69-foot (21-meter) obelisk to the United States in the 1870's. The structure is over 3,000 years old.

Clepsydra. See **Water clock.**

Clerestory, *KLIHR stawr ee,* is an architectural term for the row of windows in a wall that rises above adjacent roofs. The word is most often applied to churches where the clerestory above the main aisles admits light to the interior. Clerestory windows in many cathedrals and churches are made of beautiful stained glass. William J. Hennessey

See also **Architecture** (Romanesque architecture).

Clergy. See **Minister; Priest; Rabbi; Deacon.**

Clerk of court is an officer of a court of justice who performs many important administrative duties. The clerk keeps the court records, such as the *docket* (list of cases awaiting hearing). The clerk issues the *summons* that calls a person into court and the *judgment* that orders the unsuccessful party to do what the court has directed. The clerk also keeps the court seal and certifies as correct any court records that are needed in other legal proceedings. Jack M. Kress

Clermont was the first commercially successful steamboat. Designed by Robert Fulton, it sailed in regular passenger service on the Hudson River. Fulton sailed the wood-burning *Clermont* up the Hudson from New York City to Albany, New York, in 1807 on its first trip. Registered as the *North River Steam Boat,* the ship was generally called the *Clermont* after the home of Fulton's business partner, Robert Livingston. It was 142 feet (43 meters) long and 14 feet (4.3 meters) wide. An English-built engine drove the ship's side paddle wheels. The *Clermont* was dismantled in 1815.

Philip Chadwick Foster Smith

See also **Fulton, Robert** (with picture); **Ship** (The *Clermont*).



© James Blank, The Stock Market

Cleveland, an Ohio city on Lake Erie, is a leading industrial center and an important Great Lakes port. Shown here is a view of downtown Cleveland from Edgewater State Park on the lakefront.

Cleveland is the largest metropolitan area in Ohio and one of the leading industrial centers of the United States. Cleveland lies on the southern shore of Lake Erie, at the mouth of the Cuyahoga River. These waterways and the city's location near huge supplies of coal and iron ore helped make Cleveland an important steel producer. The city also ranks as a transportation, medical, and cultural center of the Midwest and a chief port of the Great Lakes.

Moses Cleaveland, a surveyor, founded Cleveland in 1796. The village was named for Cleaveland, but a newspaper printer misspelled the name in 1831 and it has been known as Cleveland ever since.

Facts in brief

Population: *City*—478,403. *Metropolitan area*—2,250,871. *Consolidated metropolitan area*—2,945,831.
Area: *City*—76 mi² (197 km²), excluding inland water. *Metropolitan area*—2,708 mi² (7,014 km²), excluding inland water. *Consolidated metropolitan area*—3,613 mi² (9,358 km²).
Altitude: 660 feet (201 meters) above sea level.
Climate: *Average temperature*—January, 27 °F (−3 °C); July, 73 °F (23 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—32 inches (81 centimeters). For the monthly weather in Cleveland, see **Ohio** (Climate).
Government: Mayor-council. *Terms*—4 years for the mayor and the 21 council members.
Founded: 1796. Incorporated as a city in 1836.

Largest communities in the Cleveland area

Name	Population	Name	Population
Cleveland	478,403	Euclid	52,717
Parma	85,655	Mentor	50,278
Lorain	68,652	Cleveland Heights	49,958
Lakewood	56,646	Strongsville	43,858
Elyria	55,943	North Olmsted	34,113

Source: 2000 census.





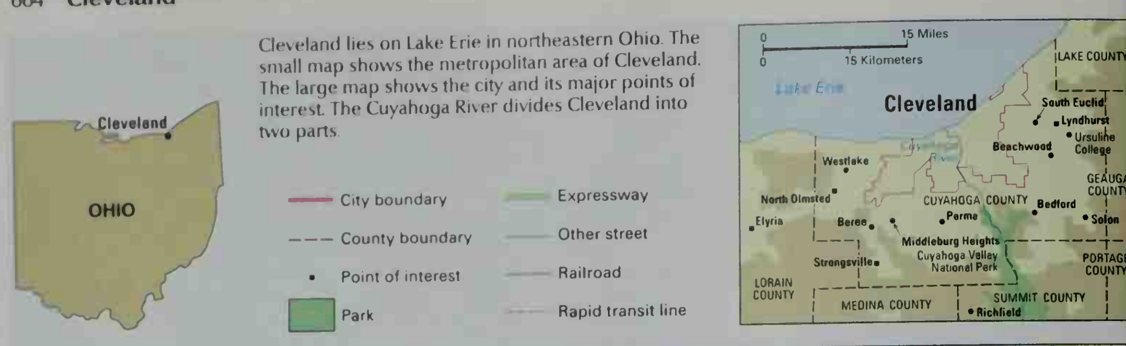
Symbols of Cleveland. The city's red, white, and blue flag was adopted in 1895. It bears a shield that resembles the city seal. The seal includes Cleveland's founding date and symbols of its industry and its waterways.

The city

A valley formed by the Cuyahoga River divides the city of Cleveland into an East Side and a West Side. Iron and steel mills and other plants operate in the valley, which is known as the Flats. The part of the Flats near where the Cuyahoga flows into Lake Erie has been redeveloped into a thriving entertainment district.

Downtown Cleveland. The layout for Cleveland's downtown area was part of a plan developed in the early 1900's by a commission headed by architect and city planner Daniel Burnham. In keeping with the commission's plan, Cleveland's public buildings border a large green space called the Mall. These buildings include the Cuyahoga County Court House, City Hall, the Cleveland Convention Center, and the Public Library.

Public Square, which lies near the Mall, covers about 10 acres (4 hectares). The city's founder, Moses Cleaveland, had set aside the land for use as a town square. A statue of Cleaveland stands in the square, along with the Civil War Soldiers and Sailors Monument and a statue of Tom L. Johnson, a progressive mayor of the early



Cleveland lies on Lake Erie in northeastern Ohio. The small map shows the metropolitan area of Cleveland. The large map shows the city and its major points of interest. The Cuyahoga River divides Cleveland into two parts.

WORLD BOOK maps

1900's. During the winter holidays, the square features an ice skating rink and colorfully lighted displays. During the summer, it serves as a site for outdoor entertainment events.

Public Square is framed by high-rise office buildings, including the Terminal Tower Building, a city landmark. The Terminal Tower Building rises 708 feet (216 meters) at the southwest corner of the square. Tower City Center, a part of the Terminal Tower complex, includes shops, restaurants, motion-picture theaters, a hotel, and offices. It is also a hub for the rapid transit system.

Cleveland's downtown lakefront underwent extensive redevelopment in the late 1900's. The lakefront attractions include a sports stadium, a science museum, and the Rock and Roll Hall of Fame and Museum.

The neighborhoods. Cleveland has about 35 neighborhoods. These residential areas spread outward from the downtown district. Like many other cities, Cleveland began experiencing decline in its neighborhoods in the mid-1900's. The decline continued for many years. But in the late 1900's, Cleveland's neighborhoods became the focus of redevelopment and revitalization efforts. These efforts included building new housing and neighborhood shopping centers, and resurfacing neighborhood streets.

The metropolitan area of Cleveland extends over six counties—Ashtabula, Cuyahoga, Geauga, Lake, Lorain, and Medina. The United States Census Bureau

calls it the Cleveland-Lorain-Elyria metropolitan area. The Census Bureau groups the metropolitan area of Cleveland-Lorain-Elyria with that of Akron to form the Cleveland-Akron Consolidated Metropolitan Statistical Area.

The Cleveland metropolitan area began to form in the early part of the 1900's, when middle- and upper-income families moving outward from the central city established a ring of suburbs around Cleveland. These communities included Cleveland Heights, East Cleveland, Euclid, Garfield Heights, Lakewood, Parma, and Shaker Heights. After World War II ended in 1945, the outward migration increased, and additional rings of suburbs were developed. Such communities as Beachwood, Solon, Strongsville, and Westlake grew rapidly. In the late 1900's, the sprawl of growth extended into the neighboring counties of Lorain, Medina, Geauga, and Lake.

The people

Ethnic groups. Cleveland's diverse population includes more than 80 nationalities. About half of the people are African Americans. Most of the rest are of European ancestry. Other residents include people of Hispanic, Asian, or American Indian background.

Education. The mayor of Cleveland has responsibility for the public school system. The mayor selects the superintendent of schools, who serves as the school district's chief executive officer. A school board, consisting of nine members, sets school policy. The mayor appoints the board members, who serve a four-year term.

Institutions of higher learning in Cleveland include Case Western Reserve University, the Cleveland Institute of Art, Cleveland State University, Cuyahoga Community College, John Carroll University, Notre Dame College, and Ursuline College.

Social problems. Cleveland's ethnic diversity presents the city's people with the challenge of developing respect and tolerance for one another. Cleveland experienced racial tensions in the 1960's. Riots occurred in the African American neighborhoods of Hough and Glenville on the East Side.

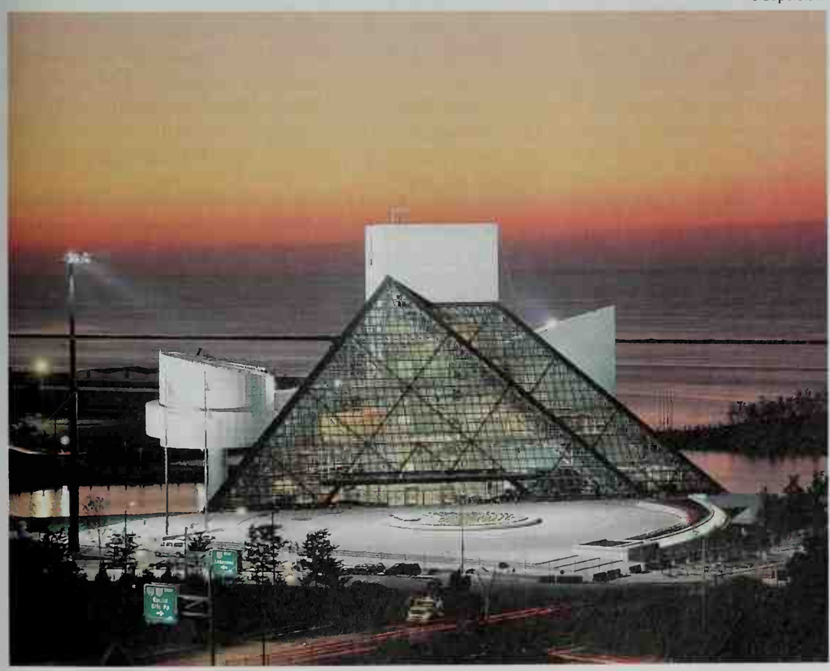
After the riots, city programs helped to ease the tensions. For example, a fund-raising program called Cleveland: Now helped finance projects to train the unemployed and find jobs for them. The city also set up child day-care centers and helped African Americans develop their own businesses. In 1982, Cleveland-area leaders established a multicultural, multiracial organization called the Greater Cleveland Roundtable to help resolve human-relations problems facing the city. The organization has opened lines of communication among community leaders and has provided a forum for the discussion of issues and the development of solutions.

A large number of the city's African Americans have been elected to local, state, and national offices, and they have assumed leadership roles in local businesses and organizations. But the level of unemployment among African Americans remains a problem. The Urban League and other civic organizations have been making efforts to reduce that level.

Cultural life and recreation

The arts. The world-famous Cleveland Orchestra performs in Severance Hall. The orchestra gives outdoor summer concerts in the Blossom Music Center near Cuyahoga Falls. The Cleveland Ballet and two opera companies also make their home in Cleveland.

The Cleveland Play House is the country's oldest regional theater. It produces plays at four theaters in the same building—the Bolton, Brooks, Drury, and Studio One theaters. Karamu House opened in 1915 as an ex-



The Rock and Roll Hall of Fame and Museum, on Cleveland's lakefront, features exhibits on rock music performers. American architect I. M. Pei designed the striking building.

periment in racial understanding through the arts. Today, its two theaters present integrated casts in dance and drama programs. The Playhouse Square Center, originally built in the 1920's, was renovated in the late 1900's. This downtown complex, which includes five theaters, is one of the largest performing arts centers in the country. Its presentations include plays, dance performances, and operas.

Museums and libraries. The city has a wide range of museums. The Cleveland Museum of Art owns one of the nation's finest collections of American, Asian, and European paintings and sculpture. The Cleveland Museum of Natural History has exhibits on the development of life on the earth. The Museum of Natural History also has a planetarium.

The Health Museum of Cleveland, which opened in 1940, was the first permanent health museum in the United States. The Rock and Roll Hall of Fame and Museum features costumes and instruments used by rock music performers, original song manuscripts, and films of rock music performances. The Great Lakes Science Center has exhibits on science, technology, and the environment, and a theater for science films.

The Cleveland Public Library is one of the largest public research libraries in the country. It has one of the nation's most extensive collections of books on open shelves. During the 1880's, the library became one of the first in the United States to adopt the open-stacks plan. This plan allows library users to select books directly from the shelves. The landmark 1920's building that is the home of the library was renovated during the 1990's, and the Louis Stokes Wing was constructed. Stokes, for whom the addition is named, served as a U.S. representative from Ohio from 1969 to 1999.

Recreation. Cleveland's largest park, 273-acre (110-hectare) Rockefeller Park, was given to the city by the industrialist John D. Rockefeller, Sr. It includes the Cleveland Cultural Gardens, a series of gardens that represent the city's nationality groups. Brookside Park is the site of the Metroparks Zoo. Parks linked by parkways surround the city in a ring about 100 miles (160 kilometers) long. Biking and walking trails run through most of the parks and parkways. The ring of parklands is referred to as the Emerald Necklace because it encircles the city with green space.

Cleveland has several professional sports teams. It is the home of the Cleveland Browns of the National Football League, the Cleveland Cavaliers of the National Basketball Association, and the Cleveland Indians baseball team of the American League.

Economy

Manufacturing is the backbone of the local and regional economy. It employs about a fifth of the the city's workers. Motor vehicle parts and steel are the city's most important products. Companies also produce biotechnology, chemicals, electronics, fabricated metal products, machine tools, and plastics.

Cleveland is an important center of new-product research and development. One focus of the city's many research institutes has been to improve the productivity and competitiveness of the older manufacturing industries. These industries have experienced major increases in productivity without increasing employment.

Service industries are an increasingly significant part of Cleveland's economy. Hospitals, colleges and universities, law firms, banks, and a wide range of service companies provide jobs for many workers. The Cleveland area is an important health care center. The Cleveland Clinic Foundation ranks as one of the leading medical institutions in the United States and is especially known for its advanced treatment of heart and kidney disease. The foundation is one of the city's largest employers. Tourism is growing as a source of income and employment.

Shipping. Cleveland's harbor is one of the busiest on the Great Lakes. From 1940 to 1959, the city spent over $20 million to widen, deepen, and straighten the Cuyahoga River. Today, ore and coal vessels travel more than 5 miles (8 kilometers) inland to steel mills. The opening of the St. Lawrence Seaway in 1959 made Cleveland an international seaport. Oceangoing ships sail the seaway from the Atlantic Ocean to the Great Lakes.

Transportation. Cleveland Hopkins International Airport lies in the southwestern section of the city, and Burke Lakefront Airport is near downtown Cleveland. Passenger and freight rail lines serve Cleveland. The Regional Transit Authority provides the chief means of local transportation. Its buses and rapid-transit lines serve the city and many suburbs. In 1968, Cleveland opened a rapid-transit line between the downtown area and Hopkins Airport. It was the first U.S. city to offer downtown-to-airport train service.

Communication. Cleveland has one daily newspaper, *The Plain Dealer.* WHK, Ohio's oldest radio station, began in Cleveland in 1922. The state's first television station, WEWS-TV, opened in Cleveland in 1947.

Government

Cleveland has a mayor-council form of government. The voters elect the mayor and the 21 members of the City Council—all to four-year terms.

Like most big cities, Cleveland has difficulty raising enough money to pay for increasingly costly city services. In 1967, the city began to tax the incomes of everyone—including suburbanites—who worked there. This tax is Cleveland's largest single source of revenue. Other sources include property taxes, local bond issues, and federal grants.

History

Early settlement. The Chippewa, Erie, and Iroquois Indians lived in the Cleveland region before the first European settlers arrived. In 1796, Moses Cleaveland, a surveyor for the Connecticut Land Company, led a group of Connecticut settlers to the site of what became Cleveland. Connecticut had held claim to a strip of land in northeastern Ohio called the Western Reserve since receiving a royal charter for it in 1662. In 1795, the Connecticut Land Company bought most of the Western Reserve, including the site of Cleveland. During the early 1800's, more settlers from New England came to the area. Cleveland became the seat of Cuyahoga County in 1810 and was incorporated as a village in 1814.

Industrial growth. The opening of the Erie Canal in 1825 provided a cheap transportation route for manufactured goods traveling to the Northwest and for raw materials going to the East. The canal helped Cleveland be-



© Corbis

Industry along the Cuyahoga River contributed greatly to Cleveland's growth. At the left in this photo, Terminal Tower, still a landmark, looms over downtown in the first part of the 1900's.

come a commercial center. In 1836, the Ohio legislature granted Cleveland a city charter. The city had a population of about 6,000 at that time.

During the last half of the 1800's, Cleveland changed from a commercial to an industrial center. The first railroad came to the city in 1851 and connected it with Columbus, the state capital. In 1852, the first boatload of iron ore from the Lake Superior region entered Cleveland's harbor. Shipments of iron ore from Minnesota and coal from Pennsylvania helped the city become a major producer of locomotives and other iron products. Between 1850 and 1870, Cleveland's population grew from 17,034 to 145,281. The city also became the chief refiner for Pennsylvania oil. In 1870, John D. Rockefeller organized the Standard Oil Company in Cleveland.

During the 1880's and 1890's, the city's rapid industrial growth attracted many settlers from other countries. Most came from Hungary, Lithuania, Poland, or Russia. By 1900, 381,768 people lived in Cleveland.

Continued growth and progress. During Tom L. Johnson's term as mayor, from 1901 to 1909, Cleveland became one of the best-governed cities in the United States. Johnson improved the police department, and he brought about lower streetcar fares. He also developed a system of taxing owners of commercial property at a higher rate than homeowners.

The development of the automobile industry during the early 1900's greatly aided steel manufacturing in Cleveland. After the United States entered World War I in 1917, the city made airplanes, ships, and tanks for the Allies, the countries opposing Germany and its partners. The rapid growth of the steel industry after the war helped Cleveland's population hit 900,429 by 1930.

During World War II (1939-1945), the city again produced war materials. Thousands of people from other parts of the United States, including great numbers of African Americans from the South, came to Cleveland seeking work in the city's defense industries. By 1950, Cleveland's population had risen to 914,808.

Downturn and racial tensions. A trend toward suburban living developed during the 1950's, and thousands of white middle-class Clevelanders moved to newly built areas outside the city. Cleveland's population fell to 876,050 by 1960.

The city faced serious racial problems in the 1960's. In July 1966, four people were killed during a five-day riot in the Hough area. Racial tension decreased in 1967 after voters elected Carl B. Stokes mayor. Stokes, a Democrat, was the first black mayor of a major U.S. city. He served until 1971. Another riot occurred in the Glenville area in July 1968. It resulted in 11 deaths.

Cleveland's population declined dramatically in the 1960's and 1970's. By 1980, it had fallen to less than 574,000. During this period, the city lost thousands and thousands of jobs as industries declined or moved to the suburbs or other regions.

Financial problems. Cleveland encountered severe financial difficulties during the 1970's. In 1978, it became the first major U.S. city since the Great Depression of the 1930's to *default on* (fail to pay when due) its loans. In 1979, voters approved an increase in the city income tax to help raise funds. Cleveland emerged from default in 1980 after city leaders and eight banks reached an agreement that enabled it to repay its overdue loans.

Comeback City. In the 1980's, Cleveland worked to recover from its financial problems. The city's efforts led to its being called the Comeback City.

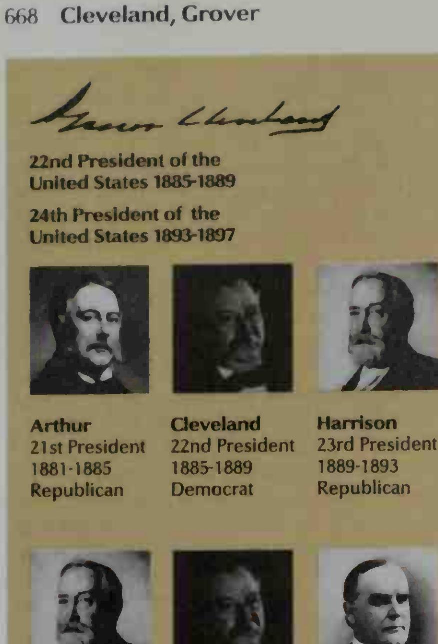
To help achieve fiscal stability, the city government eliminated hundreds of city jobs, and voters approved another income tax increase. To improve political stability, voters approved a reduction of the City Council from 33 to 21 members and changed the terms of the mayor and council members from two years to four years. The number of jobs in manufacturing continued to drop, but service industries began to develop. Cleveland's population loss slowed during the 1980's. In 1990, the population leveled off at about 500,000.

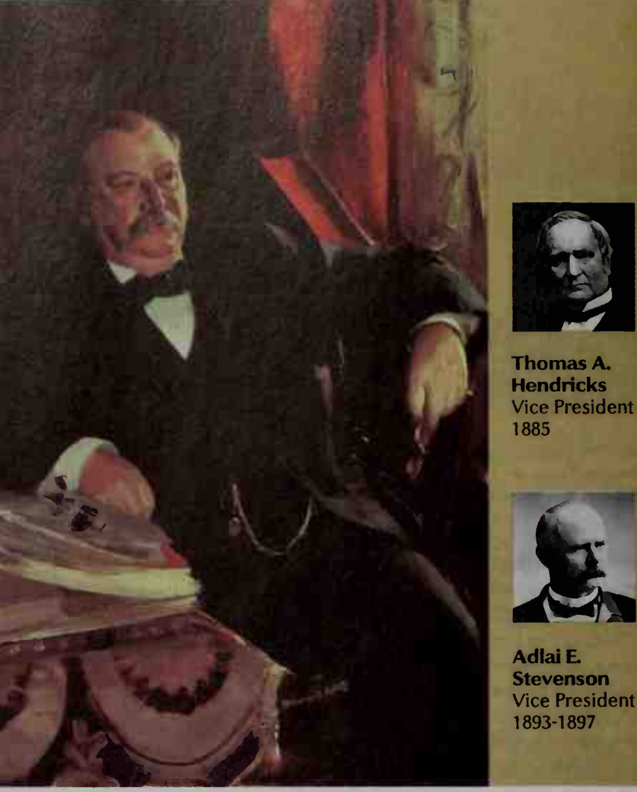
The downtown area, including the lakefront, was the site of many redevelopment projects during the 1980's and 1990's. These projects included the development of the Tower City Center with its many retail and entertainment facilities, the renovation of Playhouse Square into a major performing-arts complex, and the development of the Gateway complex, which includes a sports stadium and a sports arena. The North Coast Harbor project transformed the lakefront with a harbor, a park, a sports stadium, and two museums.

Despite Cleveland's economic comeback, the school system remained a source of concern. In 1995, after years of financial problems, the city's school system was put under state control. But in 1997, the Ohio governor signed into law a bill giving responsibility to the Cleveland mayor, who officially took control in 1998. Goals for the school system included improving student scores on state tests, increasing parent involvement, and improving school safety.

Recent developments. In 2000, the city had a population of 478,403, a decline of about 5 percent from 1990. Cleveland emerged in the 2000's with a substantially changed skyline and a new label, the New American City. But certain human issues continued to need attention, including race relations, public school reform, and job training for the unemployed. In 2001, voters elected the city's first female mayor, county commissioner and former state legislator Jane L. Campbell. David C. Sweet

See also **Stokes, Carl B.; Western Reserve.**





Detail of an oil portrait on canvas (1899) by Anders Zorn; National Portrait Gallery, Smithsonian Institution, Washington, D.C.

Cleveland, Grover (1837-1908), was the only President who served two terms that did not directly follow each other. He won the presidency in 1884, but lost it four years later to Benjamin Harrison. He ran against Harrison again in 1892 and won a second term.

Cleveland was the first Democratic President elected after the Civil War. This very fact showed that the emotions of the war had cooled enough to permit the return to a two-party system. Cleveland's victory also was a protest against the waste and corruption that had disgraced Republican administrations after the war. His honesty and common sense helped restore confidence in the government. These qualities had served him in his earlier successes as a lawyer, sheriff, and mayor, and as governor of New York.

As President, Cleveland had the courage to say "No." He said it often—to farmers who sought easy money to pay their debts, to manufacturers who wanted high protective tariffs, and to veterans who wanted bigger pensions. These "No's" made Cleveland unpopular in his time, but have added to the respect with which history holds him.

This big, good-humored man, called "Uncle Jumbo" by his relatives, occupied the White House during a time of swift social and economic change. The growing strength of labor unions and farm organizations created new problems for government. Cleveland lacked the experience and vision to find completely satisfactory answers to all the problems. He attempted to settle labor strikes by force—the legal force of court injunctions and the physical force of army troops. Cleveland clung steadfastly to his faith in "sound" money and a low tariff as a cure for the nation's other economic ills. Although Cleveland's intentions were good, his methods fell short of success.

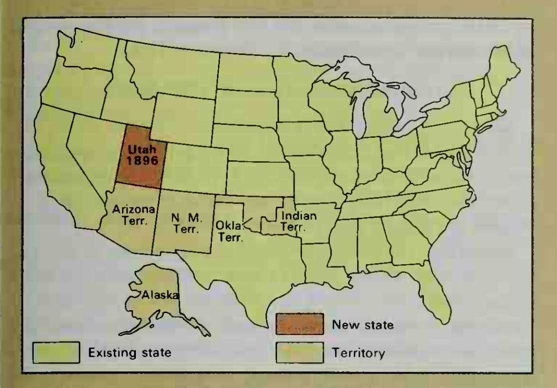
The era of the western frontier was drawing to a close when Cleveland took office. Settlers in the Southwest breathed easier when federal troops captured Geronimo, the fierce Apache leader. Jacob Riis shocked a complacent public with newspaper stories of how "the other half" lived in run-down slums.

During Cleveland's second term, the Duryea brothers built America's first automobile. A Kansas preacher, Charles Sheldon, wrote *In His Steps,* one of the world's all-time best sellers. Americans of the Gay Nineties enjoyed Victor Herbert's early operettas. At the World's Columbian Exposition in Chicago, they applauded John Philip Sousa's band and rode the first Ferris wheel ever built.

Early life

Boyhood. Stephen Grover Cleveland was born on March 18, 1837, in Caldwell, New Jersey. He dropped his first name while still a boy. Grover was the fifth child in a family of four brothers and five sisters. His father, Richard Falley Cleveland, was a Presbyterian minister and a relative of Moses Cleaveland, the founder of Cleveland, Ohio. His mother, Ann Neal Cleveland, was the daughter of a publisher.

The family of a country minister led a hard life. The Clevelands had little money and moved often. Grover attended schools in Fayetteville and Clinton, New York,



There were 38 states throughout Cleveland's first term. During his second term, Utah joined the Union in 1896, bringing the number of states to 45.



The United States flag had 38 stars when Cleveland took office in 1885. The flag had 44 stars when Cleveland began his second term in 1893. One star was added to the flag, *left,* in 1896.

The world of President Cleveland

The last spike of the Canadian Pacific Railway (now CP Rail) was driven at Craigellachie, B.C., in 1885. This railroad was the first to cross Canada.
The American Federation of Labor was founded in 1886.
The Statue of Liberty, a gift from France to the United States, was dedicated by President Cleveland in 1886.
Queen Victoria of Great Britain celebrated the golden jubilee of her reign in 1887.
The Interstate Commerce Act, approved by Congress in 1887, became the first federal law to regulate railroads and other forms of transportation in the United States.
The United States Department of Agriculture became a Cabinet-level agency in 1889.
Women's voting rights were granted by New Zealand in 1893. New Zealand was the first nation to give female citizens the complete right to vote.
The Pullman strike, a violent labor dispute in Chicago in 1894, was ended by government troops sent by President Cleveland.
X rays were discovered in 1895 by Wilhelm K. Roentgen, a German physicist.
A practical wireless telegraph system was produced in 1895 by Guglielmo Marconi, an Italian inventor.
The Red Badge of Courage, Stephen Crane's classic novel about the Civil War, was published in 1895.
Sir Wilfrid Laurier in 1896 became the first French-Canadian prime minister of Canada.
Henry Ford's first automobile appeared in Detroit in 1896. Three years earlier, the Duryea brothers had built the nation's first successful gasoline-powered car.

WORLD BOOK map

and went to work at the age of 14 as a clerk in a Fayetteville general store. He was only 16 when his father died, leaving him and his brothers to support his mother and sisters. Cleveland joined an older brother who was teaching at the New York Institution for the Blind in New York City. He taught there for a year.

Lawyer. When Cleveland was 17, he decided to go west to look for better opportunities. He planned to settle in Cleveland, Ohio, which attracted him because of its name. But he stopped in Buffalo, N.Y., to visit his mother's uncle, Lewis F. Allen, who persuaded him to stay there. Grover worked for his uncle for six months, then decided to become a lawyer. He worked as a clerk in the law office of Rogers, Bowen, and Rogers, and studied there. The serious, quiet youth worked hard for his $4 a week, which paid for room and board at the home of a fellow law clerk.

After being admitted to the bar in 1859, Cleveland continued to work for the same law firm. Two of his brothers served in the Union Army during the Civil War, but Cleveland's help was needed to support his mother and the other children. He paid a substitute to take his place in the army. Although this was legal and a common practice, the fact that he had not served in the war was later used against him by his political enemies.

Important dates in Cleveland's life

1837	(March 18) Born in Caldwell, N.J.
1881	Elected mayor of Buffalo, N.Y.
1882	Elected governor of New York.
1884	Elected President of the United States.
1886	(June 2) Married Frances Folsom.
1888	Defeated for reelection by Benjamin Harrison.
1892	Elected to second term as President.
1908	(June 24) Died in Princeton, N.J.

Political career

Minor offices. Cleveland entered politics as a ward worker for the Democratic Party in Buffalo. He served as ward supervisor in 1862 and later as assistant district attorney of Erie County. He was elected sheriff in 1870.



Gene Collerd

Cleveland's birthplace was the parsonage of the First Presbyterian Church of Caldwell, N.J., where his father was minister.

During his term, the county had to hang two convicted murderers. Most sheriffs had delegated this distasteful task to deputies, but Cleveland sprang the traps himself. He explained that he would not ask anyone else to do what he was unwilling to do.

Cleveland returned to the practice of law after three years as sheriff. He relaxed by hunting and fishing with fellow lawyers. To relatives who wondered whether their stout "Uncle Jumbo" had ever thought of marrying, he replied: "A good many times; and the more I think of it the more I think I'll not do it."

Mayor of Buffalo. Like many cities, Buffalo suffered from a corrupt administration. In response to a growing demand for reform, Democratic leaders chose Cleveland to run for mayor in 1881. He won the election, and gave his political backers more reform than they had bargained for. Cleveland vetoed so many padded city contracts that he became known as the "veto mayor."

Governor of New York. Cleveland's reputation for honest administration became a valuable political asset. The Democrats nominated him for governor in 1882 as a candidate not owned by any political faction. He won easily.

Cleveland gave New York the same conscientious administration he had given Buffalo. He vetoed padded appropriation bills regardless of political pressure. He aroused a storm of protest when he killed a bill that would have lowered streetcar fares in New York City. Cleveland explained that the bill violated the terms of a previous transit contract. Theodore Roosevelt, then a member of the state legislature, had advocated the bill, but later admitted that Cleveland had been right. When Cleveland later cooperated with Roosevelt to pass laws reforming the government of New York City, he earned the undying hatred of Tammany Hall, the Democratic political machine that controlled the city.

Election of 1884. Cleveland's reputation for good government made him a national figure. The Republican Party nominated James G. Blaine for President in 1884, even though he had been implicated in a financial scandal (see **Blaine, James G.**). Many influential Republicans were outraged. They thought the time had come for a national reform administration. These Republicans, called *mugwumps,* withdrew from the convention and declared that they would vote for the Democratic candidate if he were an honest man (see **Mugwumps**). The Democrats answered by nominating Cleveland. They chose Governor Thomas A. Hendricks of Indiana for Vice President.

Good political issues were available to both parties in the campaign. Farmers were growing poorer, private interests were grabbing public lands and resources, and labor was becoming more dissatisfied. But neither party faced these issues. Instead, each attacked the other's nominee with scandalous personal stories.

The basic unrest of the people, their lack of faith in the honesty of previous administrations, and a series of campaign blunders by Blaine turned the tide. One of the most costly mistakes was made by a supporter of Blaine at a Republican rally in New York City. Samuel D. Burchard, a Presbyterian clergyman, declared that a vote for Cleveland would be a vote for "rum, Romanism, and rebellion." This remark appealed to popular prejudices that linked the Democrats with whiskey, Roman Catholicism, and the Southern cause in the Civil War. Roman Catholics deeply resented the statement. Blaine later repudiated it, but the damage had been done. Cleveland, by 25,685 votes, became the first Democratic President to be elected since James Buchanan in 1856.

First Administration (1885-1889)

Cleveland, who faced a Republican Senate, made effective use of the presidential powers of veto, appointment, and administrative control. With these weapons, rather than with any strong legislative program, he moved to restore government efficiency.

Reforms. Cleveland ordered the members of his Cabinet to eliminate "abuses and extravagances" in their departments. As a result, the Department of the Navy tightened its supervision of shipbuilding and added several new vessels to the fleet, including the battleship *Maine.*

The Department of the Interior forced western railroads to return to the public domain vast acreages of excess right-of-way land that the railroads had held illegally. This land was forfeited because the railroads had failed to carry out their earlier agreements to extend their lines. The forfeited land equaled the combined areas of New York, New Jersey, Pennsylvania, Delaware, Maryland, and Virginia.

The spoils system had continued to flourish in spite of the Civil Service Act of 1883 (see **Spoils system**). Cleveland, like other Presidents of his era, was besieged by office seekers. He tried to steer a middle course between the reformers, who wanted him to extend civil service, and party politicians, who were hungry for jobs. He more than doubled the number of workers who held jobs through the merit system, although the total still included fewer than a fourth of all government employees. But his moderation satisfied neither the reformers nor the politicians.

Labor problems were among Cleveland's gravest concerns. Farmers had heavy debts, and the Grange and Farmers' Alliances demanded reforms. Laborers suffered from low wages and harsh working conditions. Employers in those days felt little sense of responsibility for their employees. The Knights of Labor, a labor group, grew to 700,000 members by 1886. This labor group's strike at the McCormick-Harvester plant in Chicago led indirectly to the bloody Haymarket Riot (see **Haymarket Riot**).

Cleveland distrusted workers' movements, but he acted for the best interests of the nation as he saw them. He was the first President to devote an entire congressional message to the subject of labor, although nothing came of his proposal for a permanent government arbitration board.

Cleveland's first election

Place of nominating convention	Chicago
Ballot on which nominated	2nd
Republican opponent	James G. Blaine
Electoral vote*	219 (Cleveland) to 182 (Blaine)
Popular vote	4,874,621 (Cleveland) to 4,848,936 (Blaine)
Age at inauguration	47

*For votes by states, see **Electoral College** (table).

Vice President and Cabinet

Vice President	*Thomas A. Hendricks
Secretary of state	Thomas F. Bayard
Secretary of the treasury	Daniel Manning Charles S. Fairchild (1887)
Secretary of war	William C. Endicott
Attorney general	Augustus H. Garland
Postmaster general	William F. Vilas Don M. Dickinson (1888)
Secretary of the navy	William C. Whitney
Secretary of the interior	*Lucius Q. C. Lamar William F. Vilas (1888)
Secretary of agriculture	Norman J. Colman (office established in 1889)

*Has a separate biography in *World Book.*

Veterans' affairs. Cleveland opposed many pension measures, defying the Grand Army of the Republic and other powerful pressure groups. The pension rolls had become full of fraud. Many healthy veterans claimed to be unfit for work, and widows continued to collect government money after they had remarried. Cleveland vetoed hundreds of dishonest claims.

He also vetoed the Dependent Pension Bill, which would have extended pension coverage to all disabled veterans, whether or not their disabilities were connected with military service. This bill was later passed in 1890.

The currency and the tariff were the most important issues facing Cleveland during his first term. Dissension was growing between the bankers and industrialists of the East, and the farmers of the South and West. The industrialists wanted a high tariff to protect high prices. They also wanted what they called a "sound" money system, based on gold. Farmers wanted a low tariff so they would not have to pay high prices for imported manufactured goods. They had heavy debts, and wanted money to be "cheap" in comparison with goods. That is, the farmers wanted *inflation,* so they could pay their debts with less farm produce.

The currency of the United States at this time was based on gold. But the Bland-Allison Act of 1878 required the Treasury to buy and coin at least $2 million worth of silver a month. The coins were minted on a standard that made 16 ounces of silver equal in value to 1 ounce of gold. Meanwhile, new silver mines had been discovered, and the world price of silver fell. Since the actual value of a silver dollar was less than that of a gold dollar, people exchanged their silver dollars for gold dollars. As a result, gold was drained from the Treasury.

Cleveland believed in a gold standard (see **Gold standard**). He asked Congress to repeal the Bland-Allison Act, but it refused. The government then issued bonds and sold them to banks for gold. But this helped matters for only a short time, because the drain on the Treasury's gold continued.

The tariff. Cleveland felt that tariffs should be reduced, mainly because the government was collecting more money than it spent. His supporters advised him not to bring up this controversial subject. But, in his annual message in 1887, he dared to ask Congress to lower tariffs. Congress refused, but Cleveland focused national opinion on this problem.

Other actions. The Presidential Succession Act of 1886 settled questions regarding succession to the presidency (see **Presidential succession**). One of the most important bills of Cleveland's first term was the Interstate Commerce Act of 1887. This act allowed the federal government to regulate interstate railroads.

Cleveland's family. In June 1886, Cleveland delighted the nation with his marriage to Frances Folsom (July 21, 1864-Oct. 29, 1947). The 21-year-old bride was the daughter of one of Cleveland's law partners, who had died in 1875. Cleveland was the only President to be married in the White House, and reporters pried into every detail with what he called "colossal impertinence."

The Clevelands had five children: Ruth (1891-1904), Esther (1893-1980), Marion (1895-1977), Richard F. (1897-1974), and Francis (1903-1995). Esther Cleveland was the first and only child of a President to be born in the White House.

Five years after Cleveland's death, Mrs. Cleveland married Thomas J. Preston, Jr., a Princeton professor.

Life in the White House. During Cleveland's first year in office, his younger sister Rose acted as his hostess. After his marriage, his young wife performed these official duties with ease and charm.

Cleveland was a hard-working President, particularly because he was unwilling to delegate responsibility. "He would rather do something badly for himself than have somebody else do it well," grumbled a political colleague. The President often stayed up until 2 or 3 a.m. going over official business, and sometimes answered the White House telephone himself.

As the Clevelands left the White House in 1889, Mrs. Cleveland told the servants: "I want you to take good care of all the furniture and ornaments in the house, for I want to find everything just as it is now when we come back again ... four years from today."

Election of 1888. The tariff became the main issue in the election of 1888. Benjamin Harrison, the Republican candidate, opposed tariff reduction. Neither Cleveland nor the Democratic Party waged a strong campaign.



Harper's Weekly, The Newberry Library, Chicago

The youngest first lady in the nation's history was Frances Folsom Cleveland. She was 21 years old and the President was 49 when they were married in 1886 in the White House.

Cleveland's attitude toward the spoils system had antagonized party politicians. His policies on pensions, the currency, and tariff reform had made enemies among veterans, farmers, and industrialists. Even with these enemies, Cleveland had more popular votes than Harrison. However, Harrison received a larger electoral vote and won the election. See **Harrison, Benjamin** (Election of 1888).

Between terms

New York attorney. Cleveland moved to New York City in 1889 and returned to the practice of law. The Harrison Administration reversed many of Cleveland's stringent policies. It boosted the tariff, increased the purchase of silver, and extended pension coverage. Both prices and government expenditures reached new heights. Cleveland, on the sidelines, sharply criticized Harrison's program.

Election of 1892. By the end of Harrison's term, many Americans were ready to return to Cleveland's harder policies. In 1892, the Democratic National Convention nominated Cleveland and chose Adlai E. Stevenson, a former Illinois congressman, as his running mate. The Republicans renominated Harrison and nominated Whitelaw Reid for Vice President.

The campaign centered mainly on the issue of a sound currency. The new Populist Party, formed by groups from the Grange, the Farmers' Alliances, and the Knights of Labor, polled more than a million votes. But Cleveland won easily.

Second Administration (1893-1897)

Cleveland enjoyed greater popularity at the beginning of his second term than at any other time during his presidency. He had made no promises to anyone in order to become President again. He was free to handle the country's problems as he saw fit, with Democratic majorities in both houses of Congress. But a severe financial panic swept the country only two months after he took office. Its causes included a farm depression, a business slump abroad, and the drain on the Treasury's gold reserve.

At this crucial time, physicians found that Cleveland had cancer of the mouth. Government leaders feared that the nation's shaky financial situation would become worse if the public knew of the President's illness. To keep it a secret, Cleveland boarded a friend's yacht in New York Harbor in July, and a team of surgeons removed his left upper jaw while the ship steamed up the East River. The operation was completely successful. Cleveland wore an artificial jaw made of rubber, which changed his appearance only slightly. News of the operation gradually became public, although great efforts were made to keep it secret.

Cleveland's second election

Place of nominating convention	Chicago
Ballot on which nominated	1st
Republican opponent	Benjamin Harrison
Electoral vote*	277 (Cleveland) to 145 (Harrison)
Popular vote	5,551,883 (Cleveland) to 5,179,244 (Harrison)
Age at inauguration	55

*For votes by states, see **Electoral College** (table).

Vice President and Cabinet

Vice President	*Adlai E. Stevenson
Secretary of state	Walter Q. Gresham Richard Olney (1895)
Secretary of the treasury	John G. Carlisle
Secretary of war	Daniel S. Lamont
Attorney general	Richard Olney Judson Harmon (1895)
Postmaster general	Wilson S. Bissell William L. Wilson (1895)
Secretary of the Navy	Hilary A. Herbert
Secretary of the interior	Hoke Smith David R. Francis (1896)
Secretary of agriculture	*Julius Sterling Morton

*Has a separate biography in *World Book*.

Labor unrest grew more serious with the business slump. Cleveland was not hostile to labor. But his strong belief in order and his limited understanding of changing conditions led him to use force rather than to seek constructive solutions to the new problems that faced his Administration.

One sign of discontent was "Coxey's Army," a group of unemployed men who demonstrated for government aid (see **Coxey, Jacob S.**). The Pullman strike of May, 1894, had far greater importance. Workers of the Pullman Company went on strike, and members of the American Railway Union, led by Eugene V. Debs, supported them by refusing to handle Pullman cars (see **Debs, Eugene V.**). A general railroad strike resulted. A federal court issued an injunction against the strikers because mail service had been interrupted. Disorders broke out near Chicago, and Cleveland sent federal



Library of Congress

"Coxey's Army," a group of unemployed men led by Jacob S. Coxey, marched into Washington, D.C., in 1894 during a depression. They demanded that the government create jobs.

troops, saying: "If it takes the entire army and navy of the United States to deliver a postal card in Chicago, that card will be delivered." The government broke the strike. Most people approved Cleveland's action. But Governor John P. Altgeld of Illinois, who had state militia standing ready to take action, argued that the disorders were not serious enough to warrant federal troops. Some historians believe that Cleveland exceeded his constitutional powers and violated states' rights. See **Pullman strike.**

Tariff defeat. Cleveland resumed his campaign for tariff reform, and again asked Congress to lower import duties. While the Wilson-Gorman Bill was being debated, the President issued a statement accusing uncooperative Democrats of "party perfidy and party dishonor." His comments outraged many party members, and the bill as passed in 1894 fell far short of Cleveland's goal. He let it become law without his signature because it also provided for a federal income tax. The Supreme Court later declared the income tax provision unconstitutional.

Foreign affairs. Many Americans in the 1890's felt that the United States should build a colonial empire. Cleveland wanted the United States to respect the rights of smaller, weaker nations. Events in Hawaii and Venezuela tested his principles.

Hawaii. At the end of Benjamin Harrison's Administration, American settlers in Hawaii had brought about a revolution and asked the United States to annex the islands. Cleveland's second term began before the Senate could ratify the treaty of annexation. Cleveland felt that Americans in Hawaii had involved the United States in a dishonorable action, and he withdrew the treaty from the Senate. The islands continued independent until 1898.

Venezuela. Cleveland's most popular action during his second term was his firm stand in a boundary dispute between Great Britain and Venezuela. Britain had refused for several years to allow its claim to be decided by a board of arbitration. In 1895, Secretary of State Richard Olney sent a sharp note to Britain declaring that "the United States is practically sovereign on this continent, and its fiat is law upon the subjects to which it confines its interposition." In a message to Congress, Cleveland hinted that armed force might be necessary to settle the matter. England agreed to submit the Venezuela boundary to international arbitration, and a settlement was reached in 1899. But historians have criticized Cleveland's intervention as extreme and provocative.

Saving the gold standard. A severe financial panic in 1893 caused 15,000 business failures and threw 4 million people out of work. Cleveland felt that a basic cause of the panic was the Sherman Silver Purchase Act of Harrison's Administration. In June 1893, he called a special session of Congress to repeal the act. Congress did so, but the nation's gold reserves had dwindled alarmingly. The government floated four bond issues in the next three years to replenish the gold reserves. J. P. Morgan and other financiers bought three of these bond issues, and Cleveland's opponents charged that Cleveland had betrayed the nation to Eastern bankers.

Meanwhile, the silver interests grew stronger. By the time of the Democratic convention in 1896, the "silverites" outnumbered the "goldbugs." To the dismay of Cleveland, who did not seek a third term, William Jennings Bryan won the Democratic presidential nomination. Bryan's famous "cross of gold" speech swung the party to the silver cause (see **Bryan, William Jennings**). Cleveland preferred the sound money policies of William McKinley, the Republican candidate, but he took no part in the campaign. Cleveland's popularity had reached a low ebb at the end of his term, and he spoke of his "poor old battered name" when he left the White House in 1897.

Later years

Cleveland spent his last years in Princeton, N.J. Public opinion about him gradually changed, and he regained respect. Cleveland served Princeton University as lecturer and as trustee, and enjoyed the company of Woodrow Wilson, president of the university. He wrote several magazine articles, and in 1904 published some of his lectures under the title *Presidential Problems.* He also helped reorganize the Equitable Life Assurance Society after financial scandals had damaged its reputation. People believed so strongly in him that his name restored their confidence.

After a three-month illness, Cleveland died on June 24, 1908. His last words were: "I have tried so hard to do right." Cleveland was buried in Princeton.

Oscar Handlin

Related articles in ***World Book*** include:

Harrison, Benjamin
Haymarket Riot
Hendricks, Thomas A.
President of the United States
Stevenson, Adlai E. (1835-1914)

Outline

Questions

- How was Cleveland's marriage unique?
- Why did Cleveland pay a substitute to serve for him in the Civil War?
- Why did Cleveland execute two criminals himself?
- How many Presidents have been defeated for reelection and later won a second term?
- Who were the *mugwumps*? How did they affect Cleveland's nomination in 1884?
- Historians have criticized two actions of Cleveland's second term which were popular at the time. Why?
- What actions made Cleveland an unpopular President?

Where was Cleveland's jaw operation performed? Why was it kept secret?
How did Cleveland feel about labor agitation? What did he do about it during his first term?
What words, spoken as he died, summed up his life?

Additional resources

Collins, David R. *Grover Cleveland: 22nd and 24th President of the United States.* Garrett Educational, 1988. Suitable for younger readers.
Kent, Zachary. *Grover Cleveland: Twenty-Second and Twenty-Fourth President of the United States.* Childrens Pr., 1988. For younger readers.
Nevins, Allan. *Grover Cleveland: A Study in Courage.* Dodd, 1932. Pulitzer Prize winner.
Welch, Richard E., Jr. *The Presidencies of Grover Cleveland.* Univ. Pr. of Kansas, 1988.

Cliburn, Van (1934-), is an American concert pianist. He performs works written primarily by romantic composers of the 1800's and 1900's. These composers include Johannes Brahms, Frédéric Chopin, Franz Liszt, Sergei Rachmaninoff, Robert Schumann, and Peter Ilich Tchaikovsky.

Cliburn was born on July 12, 1934, in Shreveport, Louisiana. His full name is Harvey Lavan Cliburn, Jr. His mother began teaching him to play the piano when he was 3 years old. Cliburn studied piano at the Juilliard School in New York City. He made his concert debut in Houston in 1947 but did not begin an active concert career until 1954. Cliburn first gained worldwide fame in 1958, when he won the International Tchaikovsky Piano Competition in Moscow. In 1978, he stopped giving concerts. But he resumed performing in public in 1989.

F. E. Kirby

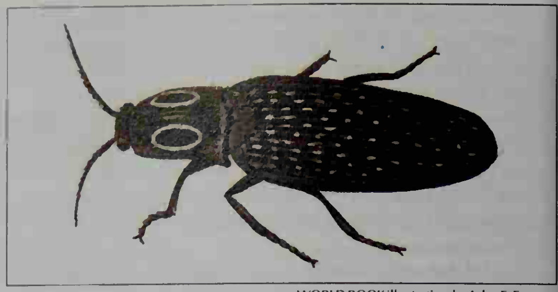


Archive Photos

Van Cliburn became a popular American concert pianist. Cliburn first gained worldwide fame in 1958 when he won the International Tchaikovsky Piano Competition in Moscow.

Click beetle is the name used for any one of a group of beetles that spring and snap. There are about 700 kinds of click beetles in the United States and Canada. Most of them have long brown bodies. But some are black, gray, or marked with bright colors.

The young of the click beetle are long, slender worms called *wireworms.* They bore into seeds of young corn, wheat, and other grains. They also feed on the roots of field and garden plants or live in decaying wood.



WORLD BOOK illustration by John F. Eggert

An eyed click beetle has two eyelike spots on its back.

Some click beetles found in tropical regions and the Southern United States can glow in the dark. One kind has two glowing spots on each side of its body. See Beetle (Kinds of beetles).

David J. Shetlar

Scientific classification. Click beetles are members of the order *Coleoptera.* They make up the click beetle family, *Elateridae.*

Cliff is a steep face of rock. Many processes of erosion form cliffs. Waves cut imposing and scenic cliffs along coastlines. Rivers create deep canyons with steep sides. Glaciers grind away the rock along valley walls and produce cliffs that appear after the glacier melts. Glaciers also pluck rock fragments away from high mountain slopes where snow collects to form walls around amphitheaterlike basins.

H. J. McPherson

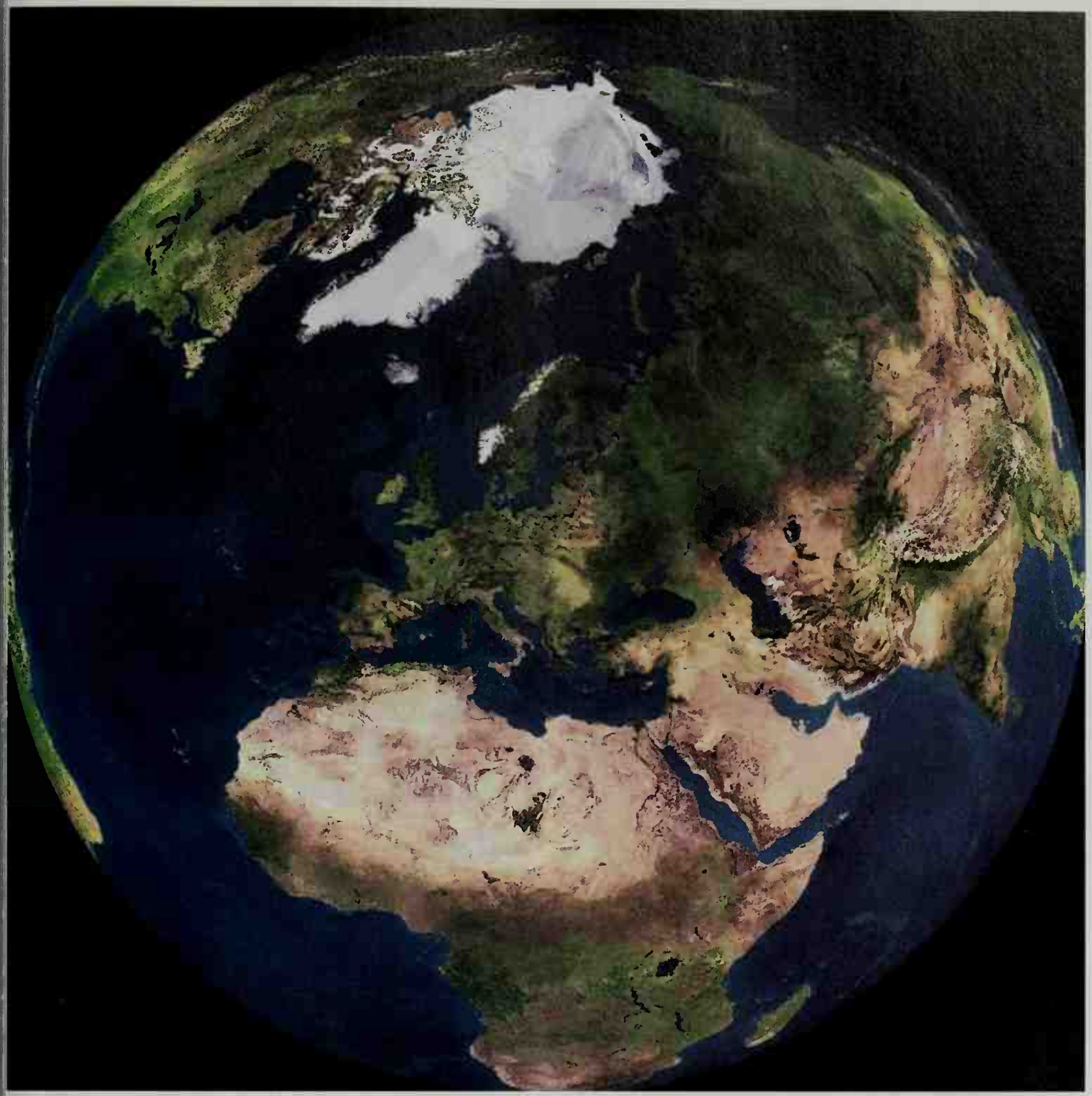
Cliff dwellers. See Anasazi.

Clifford, Clark McAdams (1906-1998), was United States secretary of defense under President Lyndon B. Johnson from March 1968 to January 1969. He became the leader of a group of officials who persuaded Johnson to de-escalate the Vietnam War. Clifford argued that the burden of fighting in the war should be transferred from U.S. troops to South Vietnamese forces.

Clifford was born on Dec. 25, 1906, in Fort Scott, Kansas. He received a law degree from Washington University in St. Louis in 1928 and practiced law in St. Louis until he entered the Navy in 1944. Clifford began his public career in 1946 as special counsel and speechwriter to President Harry S. Truman. He was also a practicing attorney in Washington, D.C.

In 1992, United States and New York state officials filed legal charges against Clifford. Federal officials charged that he, as chairman of First American Bankshares, Inc.—a Washington, D.C., bank—had helped hide the fact that the bank was illegally owned by another bank, Bank of Credit and Commerce International SA, also known as B.C.C.I. A huge international bank, B.C.C.I. had been closed in 1991 by banking regulators worldwide and charged with fraud, money laundering, and bribery. New York officials charged that Clifford had accepted bribes in return for helping B.C.C.I. officials influence First American Bankshares, Inc. In 1993, the federal charges against Clifford were dropped in order not to interfere with the New York case. The state charges were dropped due to Clifford's failing health. In 1991, Clifford published an account of his career as a government official in *Counsel to the President: A Memoir.*

Charles Bartlett



Climate varies from place to place because of distance from the equator and other factors. For example, in Africa, the continent at the bottom in this satellite photo, the vast tan area at the north is a desert, the Sahara. The green regions farther south, at and near the equator, are always hot and wet.

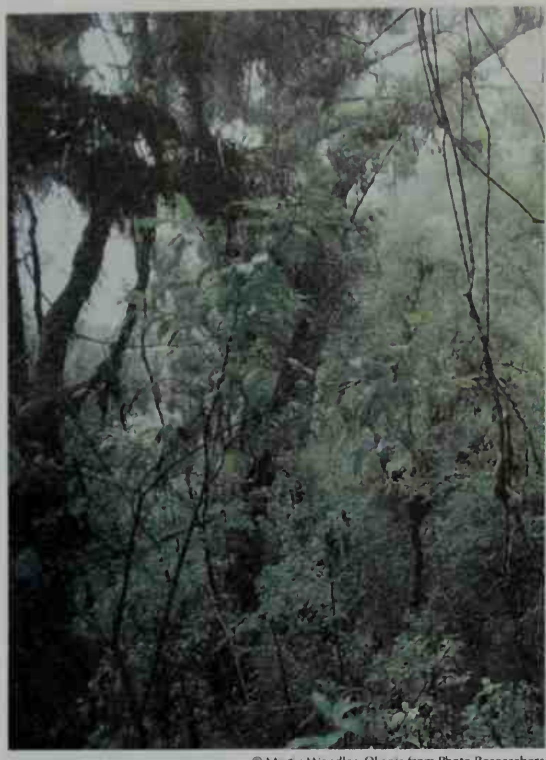
Climate

Climate is the weather of a place averaged over a length of time. The earth's climate varies from place to place, creating a variety of environments. Thus, in various parts of the earth, we find deserts; tropical rain forests; *tundras* (frozen, treeless plains); *conifer forests*, which consist of cone-bearing trees and bushes; prairies; and coverings of glacial ice.

Climate also changes with time. For example, a thousand years ago, northern latitudes were milder than they are today. The warmer climate enabled Vikings from Iceland to settle on the southern coast of Greenland. But the colder climate that developed over the following centuries wiped out the settlements.

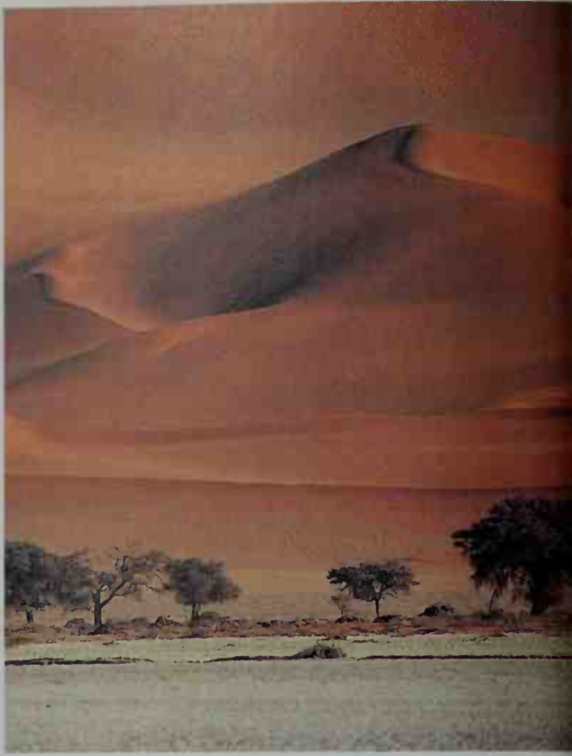
One major environmental concern is that human activity may be changing the global climate. The burning of *fossil fuels*—coal, oil, and natural gas—to power motor vehicles, heat buildings, generate electric energy, and perform various industrial tasks is increasing the amount of carbon dioxide (CO_2) gas released into the atmosphere. Fossil fuels contain carbon, and burning them produces CO_2. This gas slows the escape of heat released by the earth into space. Thus, an increase in atmospheric CO_2 may cause *global warming*—a rise in the temperature of the air next to the earth's surface.

Joseph M. Moran, the contributor of this article, is Professor of Earth Sciences at the University of Wisconsin at Green Bay.



© Martin Wendler, Okapia from Photo Researchers

A tropical wet climate supports a rain forest in South America. Rainfall is heavy, and the weather is always hot and muggy. As a result, trees and other plants grow throughout the year.



© Uniphoto

A desert climate supports only sparse vegetation and gives rise to tremendous sand dunes in the southwest African nation of Namibia. The air is hot during the day but cools rapidly at night.

Global warming could change rainfall patterns, leading to shifts in plant and animal populations. It could melt enough polar ice to raise the sea level, and it could increase the frequency and severity of tropical storms.

Why climates vary

Climates vary from place to place because of five main factors: (1) *latitude* (distance from the equator), (2) *altitude* (height above sea level), (3) *topography* (surface features), (4) distance from oceans and large lakes, and (5) the circulation of the atmosphere.

The role of latitude. The sun continually sends electromagnetic radiation into space. Most of the radiation is visible light, and it also includes *infrared* (heat) rays and ultraviolet rays. About 30 percent of the radiation that reaches the earth's atmosphere is reflected back into space, mostly by clouds. The remaining 70 percent is absorbed by the atmosphere and the earth's surface, heating them.

The intensity of the solar radiation reaching the atmosphere decreases with increasing latitude. The intensity depends on how high in the sky the sun climbs. The closer a place is to the equator, the higher the climb.

At latitudes between 23 $\frac{1}{2}$° north and 23 $\frac{1}{2}$° south, the sun is directly overhead at noon twice a year. In these cases, the sun's rays shine directly down toward the surface. The radiation that reaches the atmosphere is therefore at its most intense.

In all other cases, the rays arrive at an angle to the surface and are therefore less intense. The closer a place is to the poles, the smaller the angle and thus the less intense the radiation. Due to decreases in the intensity of radiation, average temperatures decline from the equator to the poles. Seasonal changes in solar radiation and the number of hours of sunlight also vary with latitude.

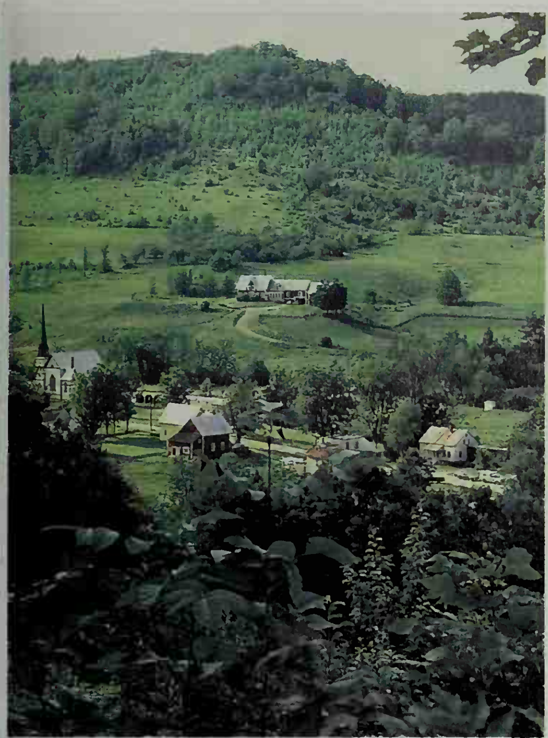
In tropical latitudes (those near the equator), there is little difference in the amount of solar heating between summer and winter. Average monthly temperatures therefore do not change much during the year.

In middle latitudes, from the Tropic of Cancer to the Arctic Circle and from the Tropic of Capricorn to the Antarctic Circle, solar heating is considerably greater in summer than in winter. In these latitudes, summers are therefore warmer than winters.

In high latitudes, north of the Arctic Circle and south of the Antarctic Circle, the sun never rises during large portions of the year. Therefore, the contrast in solar heating between summer and winter is extreme. Summers are cool to mild, and winters are bitterly cold.

The role of altitude. The higher a place is, the colder it is. Air temperature drops an average of about 3.5 Fahrenheit degrees per 1,000 feet of altitude (6.5 Celsius degrees per 1,000 meters). The temperature of the air determines how much precipitation falls as snow, rather than rain. Even in the tropics, it is not unusual for mountaintops to be snow covered.

The role of topography. The surface features of the earth influence the development of clouds and precipitation. As humid air sweeps up the slopes of a mountain range, the air cools, and so clouds form. Eventually, rain



© Maxwell MacKenzie, Uniphoto

A humid continental climate supports a rich variety of plant life during a summer in Vermont. Precipitation falls fairly evenly all year. Snow remains on the ground much of the winter.

or snow falls from the clouds. Some of the rainiest places on earth are on *windward* slopes, those facing the wind.

As winds blow down the opposite slopes, known as the *leeward* slopes, the air warms, and clouds thin out or vanish. Thus, leeward slopes of mountain ranges are dry. In addition, a *rain shadow* (dry area) may stretch hundreds of kilometers downwind of a mountain range.

Oceans and large lakes make the air temperature less extreme in places downwind of them. An ocean or lake surface warms up and cools down more slowly than a land surface. Thus, between summer and winter, the temperature of the water varies less than the temperature of the land. The temperature of the water strongly influences the temperature of the air above it. Therefore, air temperatures over the ocean or a large lake also vary less than air temperatures over land. As a result, places that are immediately downwind of the water have milder winters and cooler summers than places at the same latitude but well inland.

San Francisco and St. Louis, for example, are at about the same latitude and therefore receive about the same amount of solar radiation during the year. But San Francisco is immediately downwind of the Pacific Ocean, and St. Louis is well inland. Consequently, San Francisco has milder winters and cooler summers.

Atmospheric circulation influences climate by producing winds that distribute heat and moisture. Six belts of wind encircle the earth: (1) trade winds that blow between 30° north latitude and the equator, (2) trade winds that blow between the equator and 30° south latitude, (3) *westerlies* (winds from the west) that blow between 30° and 60° north of the equator, (4) westerlies blowing between 30° and 60° south of the equator, (5) polar winds north of 60° north latitude, and (6) polar winds south of 60° south latitude.

Trade winds north of the equator blow from the northeast. South of the equator, they blow from the southeast. The trade winds of the two hemispheres meet near the equator, causing air to rise. As the rising air cools, clouds and rain develop. The resulting band of cloudy and rainy weather near the equator is called the *doldrums.*

Westerlies blow from the southwest in the Northern Hemisphere and from the northwest in the Southern Hemisphere. Westerlies steer storms from west to east across middle latitudes.

Westerlies and trade winds blow away from the 30° latitude belt. Over broad regions centered at 30° latitude, surface winds are light or calm. Air slowly descends to replace the air that blows away. Descending air warms and is dry. The tropical deserts, such as the Sahara of Africa and the Sonoran of Mexico, occur under these regions of descending air.

Polar winds blow from the northeast in the Arctic and from the southeast in the Antarctic. In the Northern Hemisphere, the boundary between cold polar easterly winds and mild westerly winds is known as the *polar front.* A *front* is a narrow zone of transition, usually between a mass of cold air and a mass of warm air. Where the air masses overlap, storms can develop and move along the polar front, bringing cloudy weather, rain, or snow.

As the seasons change, the global wind belts shift north and south. In spring, they move toward the poles. In the fall, they shift toward the equator. These shifts help explain why some areas have distinct rainy seasons and dry seasons. Parts of Central America, North Africa, India, and Southeast Asia have wet summers and dry winters. Southern California and the Mediterranean coast have dry summers and wet winters.

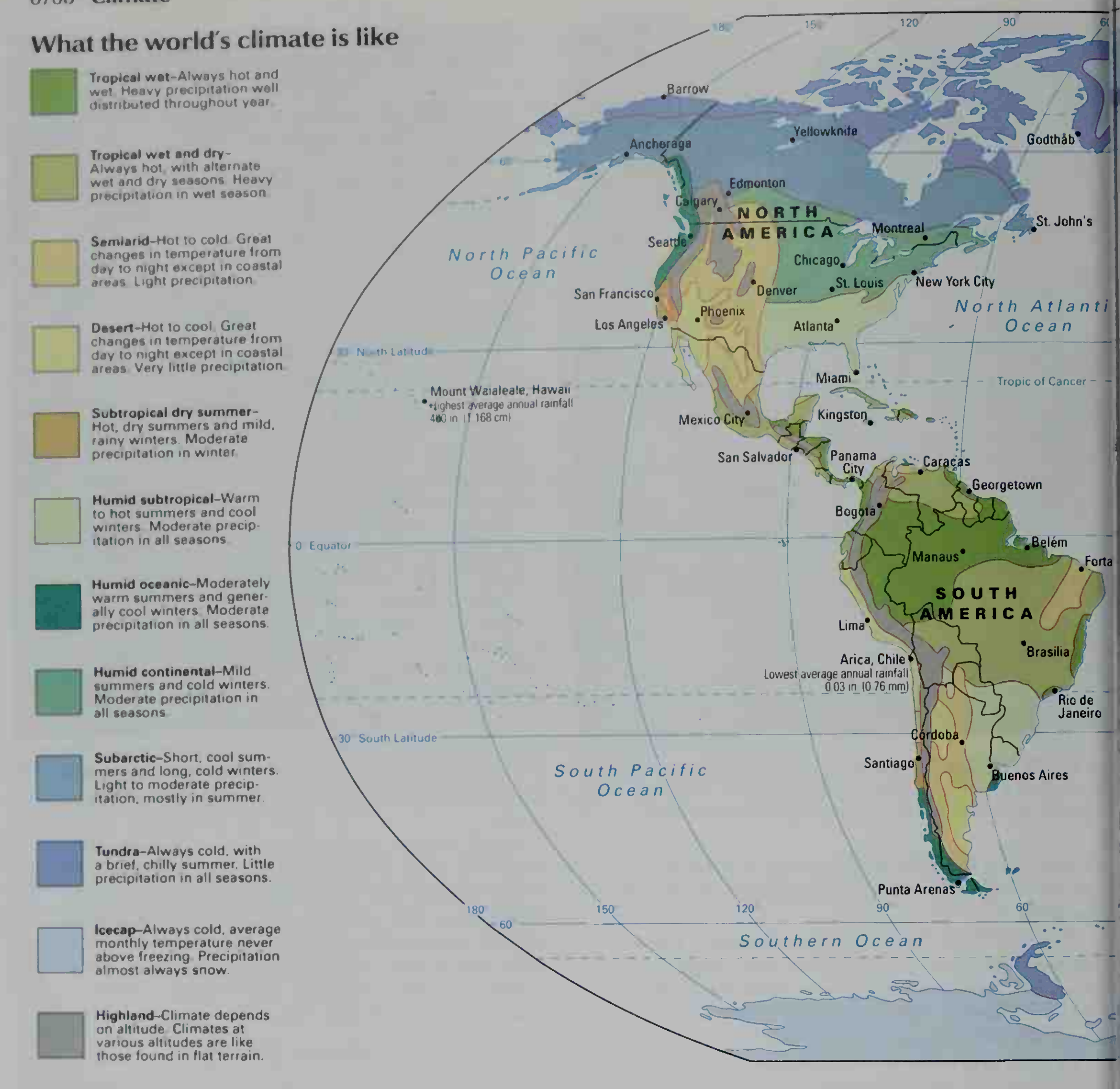
Kinds of climates

The earth's surface is a patchwork of climate zones. *Climatologists* (scientists who study the climate) have organized similar types of climates into groups. This article uses a modified version of a classification system introduced in 1918 by Wladimir Köppen, a German climatologist. Köppen based his system on a region's vegetation, average monthly and annual temperature, and average monthly and annual precipitation.

The modified version specifies 12 climate groups: (1) tropical wet, (2) tropical wet and dry, (3) semiarid, (4) desert, (5) subtropical dry summer, (6) humid subtropical, (7) humid oceanic, (8) humid continental, (9) subarctic, (10) tundra, (11) icecap, and (12) highland.

Tropical wet climates are hot and muggy the year around. They support dense tropical rain forests. Rainfall is heavy and occurs in frequent showers and thunderstorms throughout the year. Average annual rainfall varies from about 70 to 100 inches (175 to 250 centimeters).

Temperatures are high, and they change little during the year. The coolest month has an average temperature no lower than 64 °F (18 °C). The temperature difference



between day and night is greater than the temperature difference between summer and winter. Frost and freezing temperatures do not occur. Plants grow all year.

Tropical wet and dry climates occur in areas next to regions that have tropical wet climates. Temperatures in tropical wet and dry climates are similar to those in tropical wet climates, where they remain high throughout the year.

The main difference between the two climates lies in their rainfall. In tropical wet and dry climates, winters are dry, and summers are wet. Generally, the length of the rainy season and the average rainfall decrease with increasing latitude. Not enough rain falls in tropical wet and dry climates to support rain forests. Instead, they support *savannas*—grasslands with scattered trees.

Semiarid and desert climates occur in regions with little precipitation. Desert climates are drier than semiarid climates. Semiarid climates, also called *steppe climates*, usually border desert climates. In both climate groups, the temperature change between day and night is considerable. One reason for the wide swings in temperature is that the skies are clear and the air is dry. Clouds would reflect much of the sun's radiation during the day, slowing the rate of heating of the air near the surface. At night, clouds and water vapor would absorb much of the earth's radiation—most of which consists of infrared rays—slowing the rate of cooling.

Semiarid and desert climates occur over a greater land area than any other climate grouping. They occur in both tropical and middle latitudes. They cover broad east-west bands near 30° north and south latitude.

Middle latitude semiarid and desert climates are in the rain shadows of mountain ranges. Winds that descend the leeward slopes of these ranges are warm and dry. Middle latitude semiarid areas and deserts differ from their tropical counterparts mainly in their seasonal



WORLD BOOK map

temperature changes. Winters are much colder in middle latitude semiarid areas and deserts.

Subtropical dry summer climates feature warm to hot, dry summers and mild, rainy winters. These climates, sometimes called *Mediterranean climates,* occur on the west side of continents roughly between 30° and 45° latitude. The closer to the coast the area is, the more moderate the temperatures and the less the contrast between summer and winter temperatures.

Humid subtropical climates are characterized by warm to hot summers and cool winters. Rainfall is distributed fairly evenly throughout the year. Winter rainfall—and sometimes snowfall—is associated with large storm systems that the westerlies steer from west to east. Most summer rainfall occurs during thunderstorms and an occasional tropical storm or hurricane. Humid subtropical climates lie on the southeast side of continents, roughly between 25° and 40° latitude.

Humid oceanic climates are found only on the western sides of continents where prevailing winds blow from sea to land. The moderating influence of the ocean reduces the seasonal temperature contrast so that winters are cool to mild and summers are warm. Moderate precipitation occurs throughout the year. Low clouds, fog, and drizzle are common. Thunderstorms, cold waves, heat waves, and droughts are rare.

Humid continental climates feature mild to warm summers and cold winters. The temperature difference between the warmest and coldest months of the year increases inland. The difference is as great as 45 to 63 Fahrenheit degrees (25 to 35 Celsius degrees). Precipitation is distributed fairly evenly throughout the year, though many locations well inland have more precipitation in the summer.

Snow is a major element in humid continental climates. Winter temperatures are so low that snowfall can

be substantial and snow cover persistent. Snow cover has a chilling effect on climate. Snow strongly reflects solar radiation back into space, lowering daytime temperatures. Snow also efficiently sends out infrared radiation, lowering nighttime temperatures.

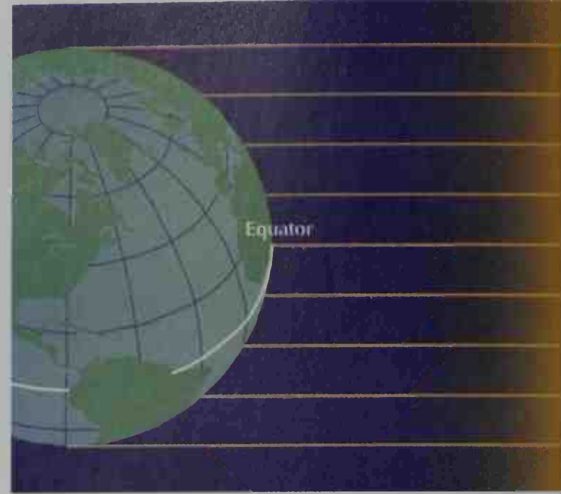
Subarctic climates have short, cool summers and long, bitterly cold winters. Freezes can occur even in midsummer. Most precipitation falls in the summer. Snow comes early in the fall and lasts on the ground into early summer.

Tundra climates are dry, with a brief, chilly summer and a bitterly cold winter. *Continuous permafrost* (permanently frozen ground) lies under much of the treeless tundra regions.

Icecap climates are the coldest on earth. They occur over the vast ice sheets that cover Greenland and Antarctica. Summer temperatures rarely rise above the freezing point. Temperatures are extremely low during the long, dark winter. Precipitation is meager and is almost always in the form of snow.

Highland climates occur in mountainous regions. A highland climate zone is composed of several areas whose climates are like those found in flat terrain. Because air temperature decreases with increasing elevation in the mountains, each climate area is restricted to a certain range of altitude.

A mountain climber may encounter the same sequence of climates in several thousand meters of elevation as he or she would encounter traveling northward several thousand kilometers. For example, the climate at the base of a mountain might be humid subtropical, and the climate at the summit might be tundra.



WORLD BOOK illustration

The sun heats the earth unevenly, producing cooler climates at increasing distances from the equator. The uneven heating occurs because the energy in the sun's rays spreads out over a greater surface area the farther the rays fall from the equator.

Causes of climate change

Climate changes over time. About 18,000 years ago, a sheet of glacial ice up to 10,000 feet (3,000 meters) thick covered much of what is now Greenland, Canada, and the northern United States. A warming trend gradually melted almost all the glaciers, except in Greenland. In Canada and the United States, the last large fields of ice had disappeared by about 11,500 years ago. The warming trend ended after a mild period from 7,000 to 5,000 years ago, when the global average temperature was higher than it is today.

Within the past 1,200 years, the period between about A.D. 950 and 1250 was mild. The years from about 1400 to 1850 were cool. Since then, global average temperatures generally have risen.

Many natural processes influence a region's climate. Some of these processes, such as volcanic eruptions, are short-lived and cause short-term changes. Other processes, such as mountain building, occur over long periods and cause long-term changes in climate. Human activity also may affect climate.

Volcanic eruptions can cause short-term cooling over large portions of the planet, especially if the eruptions throw large amounts of sulfur gases high into the atmosphere. The sulfur gases combine with moisture to produce droplets of sulfuric acid and tiny sulfate particles. The sulfur droplets and particles created by major volcanic eruptions absorb some solar radiation and reflect some back to space. As a result, less solar radiation reaches the earth's surface, and so air temperatures fall.

Because the droplets and particles are so small, they can remain suspended in the atmosphere for months or years. Meanwhile, winds carry them around the globe. Scientists believe that volcanic eruptions can cause a maximum global cooling of about 2 Fahrenheit degrees (1 Celsius degree).

In 1991, the eruption of Mount Pinatubo in the Philippines threw large amounts of sulfur gases high into the atmosphere. This eruption likely caused a drop of 1.1 Fahrenheit degree (0.6 Celsius degree) in the global average temperature during the following few years.

Changes in ocean circulation can alter the climate. For example, changes in ocean currents that occur during El Niño can affect the climate for a year or two.

El Niño is a large-scale interaction between the tropical atmosphere and tropical oceans that happens about every two to seven years. Changes in the air pressure over the tropical Pacific Ocean cause the trade winds there to weaken or even reverse direction. This change enables the warm waters of the ocean surface to drift from the western tropical Pacific to the eastern tropical Pacific. This flow makes sea-surface temperatures lower than usual over the western tropical Pacific and higher than usual over the eastern tropical Pacific.

The sea-surface temperature changes, in turn, alter the atmosphere's circulation in tropical and middle latitudes. These alterations cause weather extremes in various parts of the world. Heavy rains drench the normally arid coastal plain of western South America, drought is more likely in Hawaii and eastern Australia, and winters are wetter than normal along the Gulf of Mexico coast.

Activity on the sun's surface may affect the earth's climate for short periods. *Sunspots* are dark, relatively cool blotches that appear on the surface of the sun. *Faculae* are relatively bright, hot areas on the solar surface. The number of sunspots and faculae increases and decreases over a cycle of about 11 years. The average amount of energy given off by the sun is slightly higher during a sunspot maximum—when the number of sunspots and faculae is high. The average amount is

slightly lower during a sunspot minimum—when the number is low.

Climatologists are not sure about the relationship between changes on the sun's surface and variations in the earth's climate. During the period from 1645 to 1715, the number of sunspots was unusually low. This episode corresponds to a portion of the Little Ice Age, a time of relatively cool conditions. Climatologists have not proved, however, that the reductions in the number of sunspots caused the cooling.

Changes in CO_2 concentration in the atmosphere may cause short-term and long-term variations in the climate. Atmospheric CO_2 slows the flow of heat from the earth to space. This gas absorbs heat that radiates from the earth's surface and radiates heat back to the surface.

Human activity is currently increasing the level of atmospheric CO_2, but this level has varied significantly throughout the history of the earth. With past variations in atmospheric CO_2, the global climate has warmed or cooled. For example, about 100 million years ago, volcanic activity on the floor of the Pacific Ocean released enough CO_2 to cause global warming of perhaps 18 Fahrenheit degrees (10 Celsius degrees).

Changes in the earth's orbit about the sun may cause climate changes over tens of thousands to hundreds of thousands of years. Milutin Milankovitch, a Serbian mathematician, proposed in the 1940's that three orbital variations change how sunlight is distributed seasonally and geographically over the planet: (1) a *precession* (wobble) of the earth's axis, (2) a variation in the tilt of the axis, and (3) a variation in the path of the orbit.

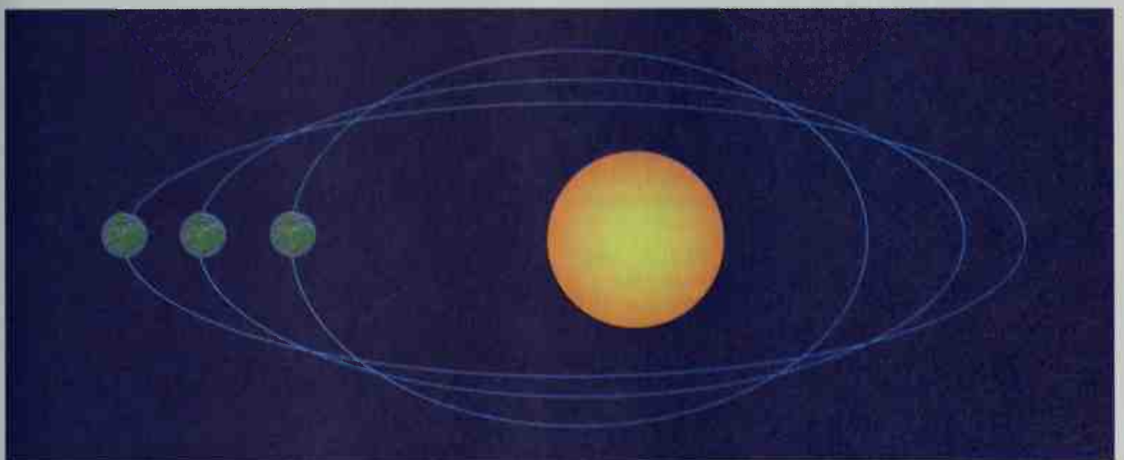
The precession of the axis varies over a period of 23,000 years. This cycle alters the times of the year when earth is closest to the sun and farthest from the sun.

The tilt of the axis changes from 22.1° to 24.5° over a period of 41,000 years. This cycle affects the contrast between winter and summer temperatures.

The path of the orbit varies over a period of 100,000 years. The orbit is always *elliptical*—that is, shaped like a flattened circle. But during the 100,000-year cycle, the

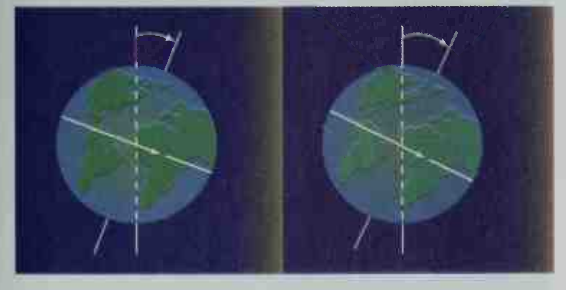
Orbital variations

Three long-term variations in the earth's orbit may cause climate changes, according to a theory proposed by Serbian mathematician Milutin Milankovitch. These variations alter the amount of sunlight striking the earth at different latitudes at different times of year, perhaps triggering periods of warming and cooling.

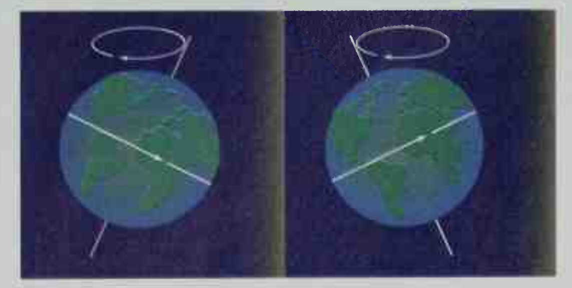


WORLD BOOK illustrations

The earth's orbit changes shape from oval to circular and back again in a cycle that lasts about 100,000 years. This change in orbit alters the distance from the earth to the sun at different times of year, varying the amount of sunlight hitting the earth. The diagram above is not drawn to scale. The orbit is much more circular than shown, and the sun is actually closer to the center of the orbit.



The tilt of the earth's axis changes from 21.1°, *above left,* to 24.5°, *above right,* and back every 41,000 years. When the tilt is 24.5°, the difference between the amount of sunlight received in summer and the amount received in winter is greater than at any other time. When the tilt is 21.1°, this difference is at a minimum.



The earth's axis *precesses*—that is, wobbles—in a cycle that lasts about 23,000 years. As a result, the seasons occur at different times of year. For example, July is now summer in the Northern Hemisphere, *above left.* In 11,500 years, after a half-cycle of precession, that hemisphere will have winter in July, *above right.*

amount of flatness changes from a maximum to a minimum, then back to the maximum. This variation changes the distance between the earth and sun over the course of a year.

These three orbital cycles probably have altered global temperatures at regular intervals throughout the earth's history. For example, climatologists believe that the cycles may have governed the major fluctuations in the planet's glacial ice cover during the Pleistocene Epoch, the period from about 2 million years ago to 11,500 years ago. The three cycles probably produced temperature changes that caused the ice cover to expand and contract at regular intervals.

Continental drift is an extremely slow process that influences the climate over periods of tens of millions of years. The planet's solid outer shell, which is typically 60 miles (100 kilometers) thick, is divided into about 30 large plates that move slowly over the surface of the globe. The continents are embedded in these plates and slowly drift with them, a process known as *continental drift.* About 200 million years ago, there was just one huge continent, called Pangaea. Pangaea split into fragments that drifted apart and eventually reached their present locations as the continents we know today.

Continental drift helps explain the presence of coral reef fossils in Wisconsin and of tropical plant fossils in areas north of the Arctic Circle. When the coral and plants were alive, Wisconsin and the arctic regions were at much lower latitudes than they are today.

Mountain building, another extremely slow process, likely helped set the stage for the ice ages during the Pleistocene Epoch. About 30 million to 40 million years ago, the Himalaya and the adjacent Tibetan plateau began to rise in southern Asia. At about the same time, mountain building began in the western part of the United States. Half the total uplift of the Himalaya and the Colorado Plateau may have occurred within the past 10 million years. The rise of these massive landforms likely altered the wind belts that encircle the planet. As a result, the earth's climate became more diverse, wetter, and colder.

Human activity also affects the climate. The building of cities, the clearing of forests, and the burning of oil, coal, and natural gas can all cause climatic changes. Climatologists disagree, however, about the impact that human activity has had on climate, particularly on the recent global warming trend.

The construction of cities creates areas that are warmer and drier than the surrounding countryside. Cities are drier because they have storm sewer systems that quickly carry off rainwater and snowmelt.

Cities are warmer for several reasons. The use of storm drainage systems means that less solar radiation is used to evaporate water and more is used to heat the city surfaces and air. The brick, asphalt, and concrete surfaces readily radiate the heat they absorb and so raise urban air temperatures even more. In addition, cities themselves generate heat from a number of sources, including motor vehicles and heating and air conditioning systems.

Large urban areas also affect the climate in the areas downwind of them. Smokestacks and automobile tailpipes in cities emit water vapor and tiny particles that stimulate the formation of clouds. Heat from a city also spurs the growth of clouds. Thus, the climate downwind from many large urban areas is cloudier and wetter than the climate upwind from those same areas.

The burning of fossil fuels has contributed to recent increases in the amount of CO_2 in the atmosphere. Since the mid-1800's, the level of atmospheric CO_2 has risen about 25 percent, mainly because of an increased use of fossil fuels for transportation, space heating, and generation of electric energy. The clearing of forests also contributes to the buildup of atmospheric CO_2 by reducing the rate at which the gas is removed from the air. Trees and other green plants remove CO_2 from the air during *photosynthesis*—the process they use to produce food.

Climatologists disagree about the impact that the burning of fossil fuels and the clearing of forests have had on climate. Global temperature records indicate that a warming trend began in the late 1800's. It was interrupted by an episode of cooling from about 1940 to the late 1970's. The cooling effect of the Mount Pinatubo eruption also interrupted the trend in the early 1990's. Some scientists argue that the buildup of atmospheric CO_2 due to human activities has caused the warming trend. Others argue that recent warming is merely a natural fluctuation of the climate.

Determining past climates

Scientists study the climate record to learn about climate and its changes. The most reliable portion of the record is based on standardized measurements by weather instruments.

The reliable instrument-based record dates back only about 125 years and is too short to reveal all possible variations in climate. Climatologists have lengthened the record by studying historical documents, tree growth rings, fossil plants and animals, deposits of pollen, and cores drilled out of glacial ice and seafloor sediments.

Historical documents that contain information about climate include logs maintained by ships' captains and lighthouse keepers, diaries kept by farmers, and records of harvests. Another source is a record of the duration of ice cover in a harbor.



© Simon Fraser, SPL from Photo Researchers

A core of ice drilled from a glacier in Greenland provides information about ancient climates. Scientists analyze the air and other substances that have been in the ice since the glacier formed.

Growth rings. A tree adds a growth ring each year. The thickness of those rings depends to some extent on seasonal weather conditions. By analyzing growth rings from living and dead trees, scientists can distinguish years of relatively favorable weather from years of stressful weather. In the southwestern part of the United States, tree growth rings provide information about the climate record dating back almost 8,000 years.

Fossils are the remains or imprints of plants and animals that lived in the past. Based on an understanding of the environmental conditions required by these organisms, scientists can reconstruct climatic conditions of the places where the fossils are found. Knowing the age of fossils, scientists can identify major shifts in climate.

Pollen consists of tiny grains that play an essential role in the reproduction of flowering and cone-bearing plants. Pollen is released by the plants and carried by the wind. Some pollen falls into lakes and settles to the bottom along with tiny bits of clay and other particles to form sediment.

Scientists can drill into a lake bottom and extract a *sediment core*—a sample of many layers of sediment. The core contains a record of changes in pollen, which reflect changes in a region's vegetation. Because climate largely determines the type of vegetation in a region, climatologists can use the pollen record to reconstruct an area's climate record.

For example, climatologists have used pollen records to determine that the average July temperature in western Europe was 3.5 Fahrenheit degrees (2 Celsius degrees) warmer 6,000 years ago. In parts of the midwestern United States, climatologists have reconstructed changes in climate from the pollen record as far back as 12,000 years ago.

Glaciers are composed of layers of ice created by the compression of winter snows. Each layer corresponds to one winter's snowfall. Through the chemical analysis of ice layers, scientists can determine winter temperatures. Tiny air bubbles trapped in the ice also provide clues about the chemical composition of the atmosphere when the snow fell. Scientists have obtained lengthy ice cores from ice sheets in Antarctica and Greenland. Cores extracted in Greenland in the early 1990's covered a period of almost 200,000 years.

Sea-floor sediments. The tiny shell and skeletal remains of organisms settle out of ocean water and accumulate with other sediment on the sea floor. A core extracted from sea-floor sediment provides a record of marine life through time. Scientists use chemical analysis of shells and skeletons removed from the sediment core to determine seawater temperatures. Analysis of deep-sea sediments revealed much of what is known about the climatic variations of the Pleistocene Epoch.

Climate models

Climatologists rely on computerized climate models to predict the earth's climate. A climatologist programs a computer with a numerical model of the climate. The model consists of a set of mathematical equations that describe how various factors influence climate. By altering one or more factors, the climatologist can use the model to predict changes in climate. One common application of climate models is to predict the impact of rising levels of atmospheric CO_2.

Joseph M. Moran

Related articles. See Weather and its list of *Related articles.* For information about the climate of individual states, provinces, and countries, see the *Climate* section in the state, province, and country articles, such as India (Climate). See also:

Adaptation
Animal (Where animals live)
Arctic (Climate)
Biome
Desert
Food (Geographic reasons)
Global warming
Greenhouse effect
Gulf Stream
Ice age
Lake (Climate)
Latitude
Nuclear winter
Ocean (As an influence on climate)
Phenology
Plant (Where plants live)
Races, Human (Climatic adaptations)
Tropics

Outline

I. **Why climates vary**
- A. The role of latitude
- B. The role of altitude
- C. The role of topography
- D. Oceans and large lakes
- E. Atmospheric circulation

II. **Kinds of climates**
- A. Tropical wet climates
- B. Tropical wet and dry climates
- C. Semiarid and desert climates
- D. Subtropical dry summer climates
- E. Humid subtropical climates
- F. Humid oceanic climates
- G. Humid continental climates
- H. Subarctic climates
- I. Tundra climates
- J. Icecap climates
- K. Highland climates

III. **Causes of climate change**
- A. Volcanic eruptions
- B. Changes in ocean circulation
- C. Activity on the sun's surface
- D. Changes in CO_2 concentration
- E. Changes in the earth's orbit
- F. Continental drift
- G. Mountain building
- H. Human activity

IV. **Determining past climates**
- A. Historical documents
- B. Growth rings
- C. Fossils
- D. Pollen
- E. Glaciers
- F. Sea-floor sediments

V. **Climate models**

Additional resources

Barry, Roger G., and Chorley, R. J. *Atmosphere, Weather, and Climate.* 7th ed. Routledge, 1998.
Bryant, Edward. *Climate Process and Change.* Cambridge, 1997.
Graedel, Thomas E., and Crutzen, P. J. *Atmosphere, Climate, and Change.* Scientific Am. Lib., 1995.
Schneider, Stephen H., ed. *Encyclopedia of Climate and Weather.* 2 vols. Oxford, 1996.

Questions

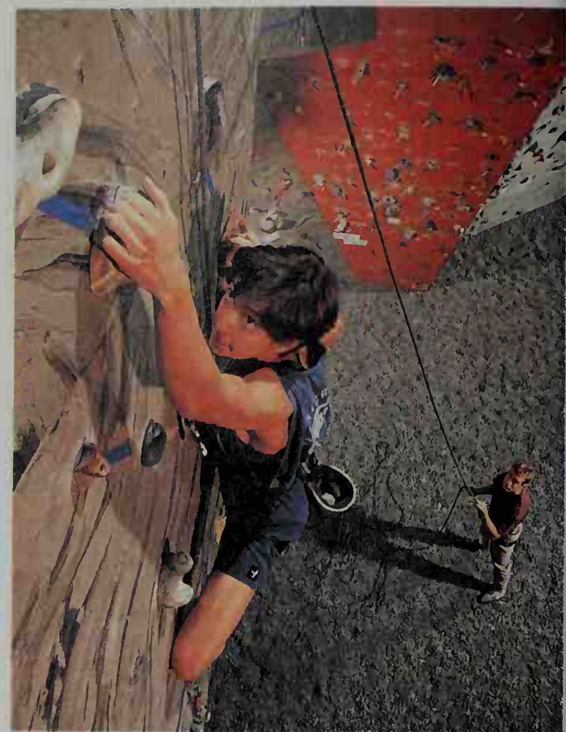
What is the difference between climate and weather?
How does latitude affect climate?
What can ice cores reveal about past climates?
What human activities contribute to a buildup of carbon dioxide in the atmosphere?
How do volcanic eruptions affect climate?
How does the building of cities affect climate?
What type of climate has the greatest temperature difference between summer and winter?
Where are highland climates found?
How does the level of carbon dioxide in the atmosphere affect climate?
What is the *El Niño* effect?

Climbing, also called rock climbing, is the sport of ascending steep rock surfaces. The sport developed during the 1800's from mountain climbing. Rock climbing close to the ground is called *bouldering.* A higher and



© Stewart M. Green

Technical climbing usually involves a *lead climber*, who ascends first, and a *belayer*. The two wear special harnesses connected by a rope. The belayer feeds the rope out to the leader.



© Don Mason, The Stock Market

Indoor climbers work on artificial surfaces in special gyms. The climber ascends by grasping *expansion bolts*. The climber is attached to a safety rope kept taut by a helper on the ground.

more difficult route is called *technical rock climbing*. Both activities can be dangerous and require instruction and specialized equipment. Many climbers also enjoy year-round climbing at indoor climbing gyms. Many schools and universities offer climbing instruction and sponsor climbing clubs.

Technical climbing. Technical climbers usually work in teams of two. One member of the team is the *lead climber*, and the other is the *belayer*. The climbers wear special shoes with smooth rubber soles and often wear protective helmets. Opposite ends of a rope manufactured for climbing, usually 150 or 165 feet (45 or 50 meters) long, are attached with a special knot to a harness worn by each climber

The lead climber ascends first, placing aluminum or brass *protection pieces* in the rock as needed. Climbers carry dozens of protection pieces in various sizes to fit different-sized cracks in the rock. Climbers attach small aluminum oval or D-shaped devices, called *carabiners* (also spelled *karabiners)* to the protection pieces and string the rope through the carabiner. This technique is designed for safety rather than assisting in the ascent. It is intended to limit the length of any fall and guarantee that a climber never falls to the ground.

The belayer provides safety for the lead climber by arranging the rope through a *belay device*, a small aluminum apparatus that provides mechanical friction. The belayer remains in a secure position and feeds the rope out as the leader makes upward progress. When the belayer ascends, he or she removes the protection pieces placed by the leader.

A climb consists of one or more *pitches*. A pitch is a portion of the total route defined by the length of the rope. After reaching the end of a pitch, lead climbers secure themselves to the rock by placing and then tying directly into protection pieces. Once the belayer is no longer necessary for the lead climber's safety, the leader pulls up any slack in the rope. As the belayer moves up, the rope is kept tight for the safety of the climber.

If the climb involves more than one pitch, the leader and belayer can reverse roles. This process is repeated until they reach the top of the rock. Climbers descend either by finding an easy way to hike back or by *rappelling*, a controlled slide down the rope using special equipment and technique.

One new style of technical climbing is called *sport climbing*. Sport climbers rely on expansion bolts placed in the rock for protection. The bolts enable them to climb smooth, steep sections of rock that may have been impossible with traditional methods.

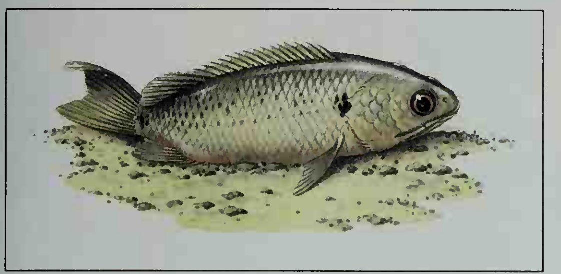
Indoor climbing. Traditional climbers rely on natural rock to train, but climbers can also learn in indoor climbing gyms. Most gyms provide artificial climbing surfaces of several levels of difficulty. Instructions and equipment rentals are often available. Indoor climbing has become so popular that national and international competitions involving difficulty and speed are regularly held. Dennis R. Jackson

See also Mountain climbing with its list of climbing schools and clubs.

Climbing perch is a group of about 40 species of small freshwater fish that can move and breathe out of

water. Sometimes called *walking fish,* climbing perch live mainly in rivers and ponds in Asia and Africa. These fish can survive in swampy waters that have a very low oxygen level. They have a specialized organ in their gill chamber that enables them to breathe air. Some climbing perch will die if they do not come to the water's surface to swallow air bubbles.

Climbing perch got their name because it was once believed that they could climb up the trunks of trees. However, they actually are only able to climb over rocks, tree roots, or fallen logs. They often crawl along the ground at night between pools of water. A climbing perch moves by raising itself on its pectoral fins while pushing forward with its tail.



WORLD BOOK illustration by Colin Newman, Bernard Thornton Artists

A climbing perch can move and breathe out of water.

Climbing perch grow to about 10 inches (25 centimeters) long. They are eaten in much of Asia. Most species make poor aquarium fishes because they attack their own kind and other fish as well.

Scientific classification. Climbing perch belong to the family Anabantidae. John E. McCosker

Cline, Patsy (1932-1963), was a popular American country music singer. During the early 1960's, her smooth emotional vocal style helped establish what became known as the Nashville Sound in country music. Unlike most female country singers of her time, Cline was bold and bawdy and wore elegant gowns as well as cowgirl costumes on stage. Her appearance and her singing style influenced many female country performers. Cline's classic songs include "I Fall to Pieces," "Crazy," "Faded Love," "Sweet Dreams," and "She's Got You," all recorded in the early 1960's. She was at the peak of her popularity when she was killed in an airplane crash near Camden, Tenn.

Patsy Cline was born Virginia Patterson Hensley in Gore, Va. She married Gerald Cline in 1953. They were divorced in 1957. She gained national recognition in 1957 after she sang "Walking After Midnight" on a television talent show. Lydia Dixon Harden

Clingmans Dome is the highest peak in the Great Smoky Mountains and in Tennessee. The mountain rises 6,643 feet (2,025 meters) on the Tennessee-North Carolina boundary, about 35 miles (56 kilometers) southeast of Knoxville. See **Tennessee** (physical map).

The Clingmans Dome area is a popular resort region. It has mountain woodlands with cool streams and a variety of plants. The road from Gatlinburg, Tenn., past Newfound Gap to near the top of Clingmans Dome is the most spectacular motor vehicle trip in Great Smoky Mountains National Park. Charles S. Aiken

Clinical psychology is the scientific study, diagnosis, and treatment of people who have psychological problems adjusting to themselves and the environment. Clinical psychologists deal with both normal and abnormal behavior. They administer and interpret psychological tests and diagnose and treat mental disorders. They study the structure and development of personality and work to prevent serious disturbances in mental health.

Clinical psychology is a scientific and *applied* field of psychology. That is, it puts into practice the theories developed in the different fields of psychology. For example, clinical psychologists apply many findings of abnormal psychology when they diagnose and treat mental disorders. They also draw knowledge from the fields of learning, motivation, perception, personality, developmental psychology, physiological psychology, and social psychology.

Clinical psychologists work in government agencies, hospitals, clinics, universities, and private practice. Their chief activities are (1) testing and diagnosis, (2) psychotherapy and consultation, and (3) research.

Testing and diagnosis. Clinical psychologists develop, administer, and interpret tests that measure aptitude, intelligence, and personality. Through their interpretation of test results, they help determine proper school placement for students of all ages. Clinical psychologists also help employers determine people's aptitudes for certain jobs. In addition, clinical psychologists use personality tests in diagnosing mental disorders.

Psychotherapy and consultation. Clinical psychologists treat mental disorders that result in disturbed human relationships or individual anxiety or unhappiness. They deal with brief, minor disturbances such as stress resulting from a school failure or grief due to the loss of a loved one. They also try to solve the prolonged problems of internal emotional conflicts often called *neuroses* and of *psychoses.* Psychoses are problems in which a person's thoughts, feelings, words, or perceptions are severely unrealistic.

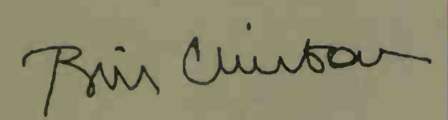
Psychotherapy is the clinical psychologist's chief tool in treating mental disorders. In most kinds of psychotherapy, the psychologist talks with the patient in a series of informal interviews. In most cases, the psychologist tries to help the patient understand the cause of the patient's personality disturbance.

Understanding and preventing mental disorders is an important goal of clinical psychologists. They develop and take part in consultation programs to educate the public in methods of improving child care and family and school relationships and expanding mental health facilities. They also work with the clergy, teachers, and other people who deal with children to help identify and solve psychological problems that develop at an early stage.

Research. Clinical psychologists are trained to design and conduct scientific experiments. Through their knowledge and use of research techniques, they improve various methods of diagnosing and treating mental disorders. They propose and test new theories on the structure and development of personality. They also develop and evaluate new testing and treatment methods.

Leah Blumberg Lapidus

See also **Mental illness** (Treatment of mental illness); **Psychotherapy**; **Testing.**



42nd president of the United States 1993-2001



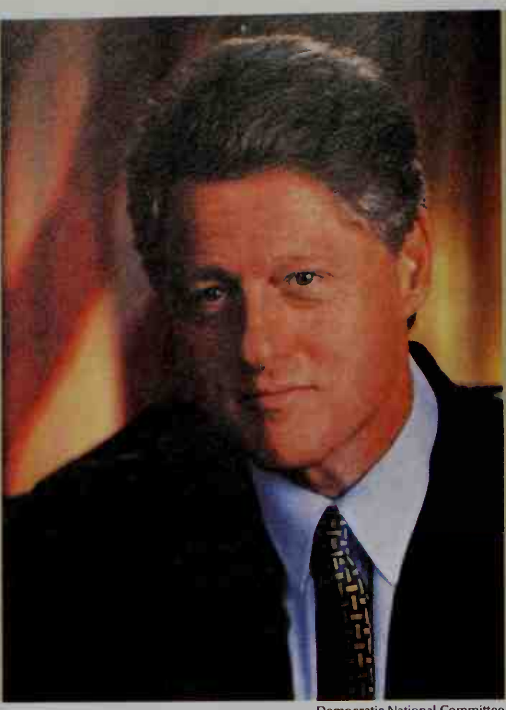
G. H. W. Bush
41st president
1989-1993
Republican



Clinton
42nd president
1993-2001
Democrat



G. W. Bush
43rd president
2001-
Republican



Democratic National Committee



Al Gore
Vice president
1993-2001

Clinton, Bill (1946-), was elected president of the United States in 1992 and reelected in 1996. A Democrat, he won the 1992 election while serving his fifth term as governor of Arkansas. President George H. W. Bush was his Republican opponent. Former Senator Robert Dole of Kansas was Clinton's Republican foe in 1996.

Clinton took office at a time when the nation's attention had shifted sharply from foreign affairs to domestic issues. The years before his election had seen a series of turbulent world events, including the end of the Cold War struggle between the United States and the Soviet Union, and—in 1991—the breakup of the Soviet Union itself. By 1992, Americans were troubled chiefly by fears about their country's economic health. The unemployment rate had climbed to the highest level since 1984. Many people were concerned about what they saw as a decline in U.S. productivity compared with that of other nations. Another concern involved the federal government's policy of *deficit spending,* or borrowing to finance expenditures, which over the years had resulted in a large national debt. In addition, Americans had become increasingly frustrated over signs of growing racial conflict, crime, and poverty.

During his two campaigns, Clinton argued that he was the best candidate to solve the country's economic and social problems. He promised to reduce the need for deficit spending and to expand the educational and economic opportunities of poor and middle-class Americans. Clinton's positions included both traditionally liberal and traditionally conservative ideas. He once declared, "The change I seek ... isn't liberal or conservative. It's different and it's both."

In December 1998, the U.S. House of Representatives impeached Clinton for perjury and obstruction of justice. The charges developed out of Clinton's efforts to conceal an improper sexual relationship. The House sent its findings to the Senate, which conducted a trial. The Senate found Clinton not guilty. For more details, see the *Domestic events* section of this article.

Clinton, who was 46 when he took office, was the third youngest person ever to serve as president, after Theodore Roosevelt and John F. Kennedy. In 1978, Clinton had become one of the youngest Americans ever elected as a governor, when he won that office in Arkansas at the age of 32. Clinton became a skillful public speaker known for his ability to seize the attention of a wide variety of audiences. His hobbies include reading, solving crossword puzzles, playing the tenor saxophone, jogging, and golfing.

Ernest C. Dumas, the contributor of this article, is a political columnist for The Arkansas Times *and Journalist in Residence at the University of Central Arkansas.*

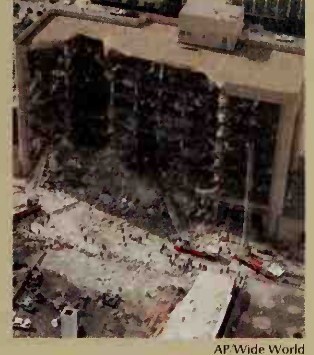
Important dates in Clinton's life

1946 (Aug. 19) Born in Hope, Arkansas.
1968 Graduated from Georgetown University.
1968-1970 Attended Oxford University as Rhodes scholar.
1973 Graduated from Yale Law School.
1975 (Oct. 11) Married Hillary Rodham.
1979-1981 Served first term as governor of Arkansas.
1982 Again elected governor of Arkansas, and later reelected three more times. Held office until 1992.
1992 Elected president of the United States.
1996 Reelected president.
1998 Impeached by U.S. House of Representatives.
1999 Tried by U.S. Senate on impeachment charges and found not guilty.



© Mike Persson, Getty Images

Nelson Mandela took the oath of office for the presidency of South Africa in May 1994. Mandela was elected president in the country's first elections open to all races.



AP/Wide World

A terrorist bombing in Oklahoma City destroyed the Murrah Federal Building on April 19, 1995. The bomb killed 168 people, including 19 children.

The world of President Clinton

The North American Free Trade Agreement (NAFTA) took effect in 1994. The pact united Canada, Mexico, and the United States in one of the world's largest free-trade zones.

A peace plan for Bosnia-Herzegovina was signed in 1995. It ended a war for independence that had begun in 1992. Under the plan, the former Yugoslav republic became an independent country divided into two parts.

The first successful cloning of a mammal from the cells of an adult animal took place in Scotland in 1996. A group of scientists led by British biologist Ian Wilmut produced a clone of a sheep, which they named Dolly.

American golfer Tiger Woods won the Masters Tournament in 1997 at the age of 21. He went on to become the youngest golfer to win all four of golf's Grand Slam tournaments during a career.

The first part of the International Space Station was launched in 1998. The station is an inhabited Earth satellite that more than 15 nations agreed to construct in space.

Indonesia's President Suharto stepped down in 1998 after 30 years in office.

The euro was adopted in 1999 by most of the members of the European Union as their basic monetary unit. The new currency replaced the countries' old notes and coins in 2002.

A milestone in medicine made the headlines in 2000. Scientists announced that they had completed a first draft of the human genome, a set of all the chemical instructions that control heredity in human beings.

Early life

Boyhood. Clinton was born on Aug. 19, 1946, in Hope, Arkansas. His given and family name was William Jefferson Blythe IV. His parents were Virginia Cassidy Blythe (1923-1994) and William Jefferson Blythe III (1918-1946). His father, a traveling heavy-equipment salesman and former automobile dealer, was killed as a result of a car accident three months before Bill was born.

During the first years of his life, young Bill—called Billy—lived with his mother and her parents in Hope. When the boy was about 2, his mother left him in the care of his grandparents for a year while she studied in New Orleans to become a nurse-anesthetist. When Billy was 4, his mother married Roger Clinton (1909-1967), a car dealer. The family lived for a time in Hope, then moved to Hot Springs, Arkansas, in 1953. There, Virginia and Roger Clinton had another son, Roger, Jr. (1956-). Billy began using his stepfather's last name while in elementary school. He formally changed his name to William Jefferson Clinton when he was 15.

Virginia Clinton had a strong influence on her older son. She cared deeply about the problems of people she met in her hospital work, and she and Bill often had long conversations about situations one or the other considered unfair. But Clinton's life at home was not easy. Roger Clinton, Sr., was an alcoholic who some-



Clinton Birthplace Foundation

The Clinton birthplace was this frame house in Hope, Arkansas. He lived in Hope from his birth in 1946 until 1953, when he and his family moved to Hot Springs, Arkansas.



Clinton Campaign Headquarters

Seventeen-year-old Clinton shakes hands with President John F. Kennedy. Clinton's meeting with Kennedy helped persuade the youth to pursue a political career.

times verbally or even physically abused his wife. At least once, Bill stood up to his stepfather to protect his mother. Clinton later said that his troubled family life made him skilled at solving disagreements and avoiding conflicts. Clinton grew close to his stepfather shortly before the older man died of cancer in 1967.

School life. In Hot Springs, Clinton attended a Roman Catholic school for two years before enrolling in public school. The Clintons, who were Baptists, sent their son to the smaller Catholic school to ease his move to the large public school system of Hot Springs. In high school, he was active in a variety of clubs and held many offices. He also played tenor saxophone in the high school band and was band major as a senior.

Clinton early showed an interest in—and a gift for—politics. As a schoolmate recalled, Bill was always "running for something." Clinton became interested in politics in 1963, when, at the age of 17, he met President John F. Kennedy. He met Kennedy while visiting Washington, D.C., as a delegate to the American Legion Boys Nation, a citizenship training program in which young people form a model of national government.

College and law school. After graduating from high school in 1964, Clinton attended Georgetown University in Washington, D.C. He majored in international affairs. He served as class president during his freshman and sophomore years. From 1966 to 1968, he helped pay his college expenses through a job with the Senate Foreign Relations Committee.

Clinton had been strongly influenced by African Americans' fight for social justice during the civil rights movement of the 1950's and 1960's. In April 1968, the assassination of civil rights leader Martin Luther King, Jr., led to rioting in Washington. Clinton worked as a Red Cross volunteer during the rioting, helping to bring food and clothing to people whose homes had been burned. He graduated from college a few months later.

Following his graduation, Clinton entered Oxford University in Oxford, England, as a Rhodes scholar. He remained at Oxford for two years. Clinton entered Yale Law School in 1970. From August to November 1972, he worked in Texas as a state coordinator for the presidential nomination of George McGovern.

Clinton's family. At Yale, Clinton met fellow law student Hillary Rodham (Oct. 26, 1947-) of Park Ridge, Illinois. Hillary and Bill began to date in 1971 and were married on Oct. 11, 1975. The couple had one child—a daughter, Chelsea (1980-). After the marriage, Hillary continued to pursue her own career as an attorney, eventually becoming one of the nation's most prominent lawyers. She also played an active role in public affairs. She remained known as Hillary Rodham until 1982, when she adopted her husband's last name.

Entry into politics

After receiving his law degree in 1973, Clinton returned to Arkansas. There, he joined the faculty of the University of Arkansas Law School in Fayetteville. Soon afterward, he decided to run for a seat in the U.S. House of Representatives. In 1974, Clinton became the Democratic nominee to represent Arkansas's Third Congressional District, which includes Fayetteville. Representative John Paul Hammerschmidt, a popular Republican, narrowly defeated Clinton in the general election.



Reuters/Archive Photos

Clinton's family includes his wife, Hillary Rodham Clinton, and their daughter, Chelsea. The family greeted supporters from a train platform during the 1996 presidential campaign.

In 1976, Clinton won the Democratic primary for attorney general of Arkansas. He ran unopposed in the general election. As attorney general, Clinton became known as a supporter of consumers' interests. He opposed the construction by an Arkansas utility company of two large coal-burning power plants, demanding that the company promote efficiency and conservation instead. The plants were eventually built.

Clinton became a candidate for governor of Arkansas in early 1978. In his campaign, he partly focused on a need for economic development and improvements in the state's educational system. Clinton overwhelmed his four Democratic opponents in the primary, winning 60 percent of the vote. He easily defeated Republican Lynn Lowe in the general election. Clinton's impressive showing, combined with his liberal policies and his youth, brought him his first national attention.

Governor of Arkansas, 1979-1981

Early difficulties. Clinton was inaugurated governor in January 1979. Once in office, he began efforts to establish a wide range of programs and policies. But he failed to gather broad support for these efforts, and most of them met with little success. To pay for a road improvement program, Clinton pushed through the legislature a measure increasing various fees and taxes, including motor vehicle license fees. The increase in license fees was extremely unpopular. Clinton also came under attack by local leaders, who said he failed to attract industries to the state. In addition, the powerful wood-products industry began working against Clinton because his administration had condemned one of its timber-management practices, called *clearcutting.*

Reelection defeat. Clinton ran for reelection in 1980 against conservative Republican Frank D. White, a savings and loan executive. White stressed Clinton's unpopular license fee increase. White also profited from a federal government decision to hold about 18,000 Cuban refugees temporarily at Fort Chaffee, then a military reserve training facility, near Fort Smith, Arkansas. In May

and June 1980, discontent among the Cubans led to breakouts and rioting. White claimed that Clinton had not done enough to persuade President Jimmy Carter to hold the Cubans elsewhere. In the election, White gained 52 percent of the vote to Clinton's 48 percent. Clinton then returned to private life, joining the law firm of Wright, Lindsey and Jennings in Little Rock, Arkansas. He began making plans to challenge White in 1982.

Governor of Arkansas, 1983-1992

Return to office. In his 1982 campaign, Clinton worked to convince voters that he understood his mistakes and had matured. He failed to win a majority of the votes in the Democratic primary, but he won the nomination in a runoff. In the general election, Clinton defeated White by 55 percent to 45 percent of the vote. Clinton returned to office in January 1983. In his second term, he abandoned some strongly liberal positions. In addition, he decided to focus on two main problems—education and the economy—instead of a wide range of issues.

Clinton's opponents argued that his 1980 defeat had taught him to avoid taking stands that might be unpopular. But Clinton was reelected in 1984 and in 1986, each time by a wide margin. In 1984, Arkansas passed a constitutional amendment changing the governor's term of office from two years to four, beginning with the 1986 election. Clinton was elected to a fifth term in 1990.

Reforms in education. Beginning in 1983, Clinton set as his main goal the improvement of the Arkansas public school system. Arkansas had long ranked near the bottom of the states in many measures of educational achievement. During his first term, Clinton had taken steps toward improving education in Arkansas. In one such move, he proposed a bill—passed into law in 1979—that required new teachers to pass a certifying examination before being allowed to teach.

In 1983, at Clinton's urging, the legislature passed a series of educational reforms. These reforms included a requirement—the first of its kind in the nation—that teachers pass a basic skills test to keep their jobs.



© *Arkansas Democrat-Gazette* from Sipa Press

Clinton's inauguration as governor of Arkansas in 1983 marked his return to office after two years in private life. Clinton had been elected governor in 1978 but lost a reelection bid in 1980. He was elected to a total of five terms as governor.

Economic developments. Arkansas had traditionally been a state with few major resources and an underdeveloped economy. It had relied heavily on low-skill, low-paying manufacturing jobs. During his first term, Clinton had sought unsuccessfully to reduce the state's dependence on manufacturing jobs. After his reelection, he worked instead to broaden its industrial base. In 1985, at his urging, the legislature passed an economic package designed to attract businesses and capital to Arkansas. His actions helped Arkansas reduce unemployment and increase production in the late 1980's and early 1990's.

Steps to the presidency. Throughout his years as governor, Clinton played an active role in Democratic Party politics. In 1985, he was elected vice chairman of the National Governors' Association (NGA), made up of the governors of the 50 states and 5 U.S. territories. Clinton served as NGA chairman in 1986 and 1987. In 1990 and 1991, he headed the Democratic Leadership Council, an organization of moderate Democratic officeholders from all levels of government, as well as business and community members. In 1987 and 1988, Clinton worked to obtain the support of Congress and President Ronald Reagan for the NGA's proposals on welfare reform. The proposals led to passage of the Family Support Act of 1988, which required welfare mothers to work if they had no children under 3 years of age.

At the Democratic National Convention in 1988, Clinton gave the speech nominating Michael S. Dukakis as the party's candidate for president. Dukakis lost the election to George H. W. Bush, then vice president.

Election as president

The Democratic nomination. In October 1991, Clinton formally announced his candidacy for the Democratic nomination for president. His chief challengers for the nomination were former Massachusetts Senator Paul E. Tsongas and former California Governor Edmund G. Brown, Jr., known as Jerry.

For a time, Clinton's campaign faltered over charges of marital infidelity. The Clintons acknowledged that they had encountered some difficulties in their relationship, but they said their marriage was strong. Clinton also came under attack for his actions during the early 1970's, which, his opponents charged, showed that he had sought to evade military service during the Vietnam War (1957-1975). Clinton denied that he had acted improperly, and his campaign rapidly regained ground. Tsongas, an early front-runner, suspended his campaign for lack of funds in March 1992. Clinton had already

Clinton's first election

Place of nominating convention	New York City
Ballot on which nominated	1st
Republican opponent	George H. W. Bush
Independent opponent	Ross Perot
Electoral vote*	370 (Clinton) to 168 (Bush) and 0 (Perot)
Popular vote	44,908,233 (Clinton) to 39,102,282 (Bush) and 19,721,433 (Perot)
Age at inauguration	46

*For votes by states, see **Electoral College** (table)

seized a commanding lead over Brown, and he soon had enough delegates to ensure the nomination.

At the Democratic National Convention in New York City in July 1992, Clinton was named the Democratic presidential nominee. At his request, Senator Al Gore of Tennessee was nominated for vice president. The Republicans renominated President Bush and Vice President Dan Quayle to oppose Clinton and Gore.

The 1992 election. During the presidential campaign, Clinton took advantage of many Americans' perception of Bush as unconcerned about domestic issues. He seized upon the high unemployment rate and the widespread belief that the gap between rich and poor had grown under Bush and his predecessor, Ronald Reagan. Clinton promised to stimulate the economy by encouraging business expansion in various ways, including tax breaks for new factories, new technology, and new small businesses. He proposed to reduce government spending and to raise taxes on wealthy Americans to help reduce the federal budget deficit.

Bush charged that Clinton lacked experience in foreign affairs. He defended his record on the economy, claiming that Congress—which was made up largely of Democrats—had rejected most of his proposals.

Texas businessman Ross Perot ran for president as an independent. Clinton defeated Bush and Perot.

Clinton's first administration (1993-1997)

National affairs. Clinton appointed more women and minority members to his Cabinet than had any previous president. Early in his presidency, he concentrated on the economy and other domestic issues.

Vice president and Cabinet

Office	Name
Vice president	*Al Gore
Secretary of state	*Warren M. Christopher
	*Madeleine K. Albright (1997)
Secretary of the treasury	*Lloyd M. Bentsen, Jr.
	*Robert E. Rubin (1995)
	Lawrence H. Summers (1999)
Secretary of defense	*Les Aspin
	*William J. Perry (1994)
	*William S. Cohen (1997)
Attorney general	*Janet Reno
Secretary of the interior	Bruce E. Babbitt
Secretary of agriculture	*Mike Espy
	Dan Glickman (1995)
Secretary of commerce	*Ronald H. Brown
	Mickey Kantor (1996)
	William M. Daley (1997)
	*Norman Y. Mineta (2000)
Secretary of labor	Robert B. Reich
	Alexis M. Herman (1997)
Secretary of health and human services	Donna E. Shalala
Secretary of housing and urban development	*Henry G. Cisneros
	Andrew M. Cuomo (1997)
Secretary of transportation	*Federico F. Peña
	Rodney E. Slater (1997)
Secretary of energy	*Hazel R. O'Leary
	*Federico F. Peña (1997)
	*Bill Richardson (1998)
Secretary of education	Richard W. Riley
Secretary of veterans affairs	*Jesse Brown
	Togo D. West, Jr. (1998)
	†Hershel W. Gober (2000)

*Has a separate biography in *World Book*. †Acting secretary.

In October 1993, Clinton sent Congress a plan for sweeping reform of the nation's health care system. A committee headed by Hillary Clinton had developed the plan. After much debate, Congress chose not to act on the proposal. In August 1996, however, Congress approved the Kennedy-Kassebaum bill, which included two important parts of Clinton's 1993 plan. The bill provided (1) that workers can change jobs without losing their medical insurance coverage, and (2) that workers cannot be denied medical insurance coverage because of a preexisting illness.

In November 1993, Congress approved the "Brady bill," which Clinton backed strongly. The bill required people to wait five working days between the time they bought a handgun and the time they took possession of it. In August 1994, Clinton won a victory when Congress passed an anticrime law he supported. The law called for spending billions of dollars on crime prevention, law enforcement, and prison construction. It also outlawed the sale of certain types of *assault weapons,* guns that many people believe are designed specifically for killing or injuring people.

The unemployment rate declined after Clinton became president. Clinton's 1993 and 1994 budgets included cuts in government spending and tax increases that helped reduce the federal deficit. They were approved by Congress, which had a Democratic majority. In the elections of November 1994, however, the Democrats lost control of Congress to the Republicans. The Republicans called for larger spending cuts, with the goal of erasing the deficit by the year 2002. Clinton said some of the proposed cuts were too sharp, including those for spending on education, welfare, and Medicare. He responded with his own plan to wipe out the deficit.

By the start of the government's new fiscal year on Oct. 1, 1995, Congress had failed to pass some of the appropriations bills that fund the government's operations. It then passed a series of bills to allow spending to continue for short periods. But the bills included certain other provisions that Clinton opposed. For example, one bill increased Medicare premiums. Clinton vetoed bills with provisions he opposed, and Congress refused to remove the provisions. The resulting lack of funding forced many federal government operations to shut down for 6 days in November and for 21 days from December 1995 to January 1996.

As president, Clinton pressed for actions to keep young people from starting to smoke. He and his administration worked to persuade Congress to create federal restrictions on smoking by people under the age of 21. For more details on government actions on smoking, see Smoking (Smoking regulations).

In 1996, Congress created legislation to revise the welfare system. Clinton vetoed two bills, claiming they included changes that would harm the poor too much. But he approved a third welfare bill in August 1996, upsetting many in his own party. The bill placed limits on how long people can receive welfare benefits, and it shifted much responsibility for administering welfare from the federal government to the states.

Clinton called for an increase in the legal minimum wage. Congress approved an increase in August 1996.

During his presidency, Clinton struggled to clear himself of charges of financial misconduct. The charges cen-

tered on alleged illegal and unethical acts by the Whitewater Development Corporation, a small company that bought land in Arkansas for a vacation home development. The Clintons had invested in the company in 1978, shortly before Clinton was elected governor of Arkansas, and sold their interest in the company in 1992. They denied any wrongdoing and pointed out that they had lost a large sum of money on their investment. But Clinton promised a full investigation.

In January 1994, Attorney General Janet Reno appointed a Republican lawyer, Robert B. Fiske, as an independent counsel to investigate the Whitewater affair. In August 1994, a panel of federal judges appointed another Republican lawyer, Kenneth W. Starr, to take Fiske's place. Republicans had charged that Fiske was favoring the Clinton Administration.

International affairs presented Clinton with many challenges. In August 1994, he ended a long-standing U.S. policy of accepting almost all refugees from Communist Cuba. He abandoned the old policy after thousands of Cubans set out for southern Florida on small boats and rafts to escape poverty in Cuba. Clinton's action was designed, in part, to avoid the cost of settling large numbers of refugees in the United States.

Since the last years of Bush's presidency, thousands of refugees from Haiti had also tried to reach the United States by sea. They left Haiti after Haiti's military overthrew Jean-Bertrand Aristide, the nation's first democratically elected president, in 1991. The new rulers set up a military dictatorship.

In September 1994, Clinton threatened to use armed force against Haiti's rulers if they did not allow Aristide to return to power. As U.S. forces prepared to invade Haiti, Haiti's top military leader, Lieutenant General Raoul Cédras, agreed to step down and allow Aristide's return. The agreement was negotiated by a U.S. team led by former President Jimmy Carter, whom Clinton had sent to Haiti as his representative. U.S. troops were sent to help ensure the transfer of power to Aristide.

Clinton achieved one of his major foreign policy goals in November 1993, when Congress approved the North American Free Trade Agreement (NAFTA). Clinton strongly supported the pact, which will gradually eliminate tariffs and other trade barriers between the United States, Mexico, and Canada. In December 1994, Clinton won Congress's approval of an expansion of the General Agreement on Tariffs and Trade (GATT). This expanded GATT plan called for large reductions in trade barriers among many nations.

The United States and other countries have long claimed that Japan's trade practices unfairly restrict imports to that country. In 1995, Clinton threatened increases in tariffs on Japanese luxury cars. Japanese car companies then agreed to try to improve their practices.

Clinton's second election

Place of nominating convention	Chicago
Ballot on which nominated	1st
Republican opponent	Robert Dole
Reform Party opponent	Ross Perot
Electoral vote*	379 (Clinton) to 159 (Dole) and 0 (Perot)
Popular vote	47,402,357 (Clinton) to 39,198,755 (Dole) and 8,085,402 (Perot)
Age at inauguration	50

*For votes by states, see Electoral College (table).



AP/Wide World

Running mates Clinton and Al Gore accepted the Democratic nomination for president and vice president at the Democratic Party's 1996 national convention in Chicago.

In 1992, a civil war began in Bosnia-Herzegovina between Bosnian Serb rebels and the country's government, which was dominated by Bosnian Muslims. Bosnia-Herzegovina, sometimes simply called Bosnia, was formerly a republic of Yugoslavia. In 1991, the United Nations (UN) had approved an embargo against providing arms to any of the former Yugoslav republics to try to keep fighting from spreading in the area. The UN sent a peacekeeping force to Bosnia. The United States used its Air Force to help provide relief to Bosnian Muslims under siege and to try to stop Serb aggression.

Televised brutal actions by Serbs in the Bosnian civil war caused many people in the United States to favor providing arms to the Muslims. Clinton continued to follow the UN arms embargo policy, however. In August 1995, Congress voted to require Clinton to end U.S. participation in the arms embargo if the UN force in Bosnia pulled out. Clinton vetoed the legislation.

In late 1995, Clinton helped bring about a meeting of representatives of the sides in the Bosnian civil war. In December, they signed a peace plan that included a cease-fire. Under the plan, the cease-fire was to be policed by a force of troops from the North Atlantic Treaty Organization (NATO). Clinton agreed to send United States troops to Bosnia to serve in the force.

In 1991, a coalition of nations led by the United States had driven Iraqi forces out of Kuwait after the Iraqis had occupied that country. The coalition then placed restrictions on Iraq. But in September 1996, Iraqi forces attacked Kurds in northern Iraq in violation of the restrictions. In response, Clinton ordered the U.S. military to launch missiles against military targets in Iraq.

Life in the White House. The Clintons often hosted small dinners and occasionally had overnight guests at the White House. They especially enjoyed inviting friends to watch a movie with them in the White House theater. They worked to maintain as normal a lifestyle as possible for their teen-aged daughter, Chelsea. Chelsea attended a private school in Washington, D.C, during Clinton's first term. In 1997, she left for college. She went to Stanford University and graduated in 2001, after Clinton left office.

Mrs. Clinton played an active role during the Clinton administration. For example, she chaired the task force on national health care reform. She also took a special interest in the problems of children and families. Her book *It Takes a Village* (1996) calls for community participation in helping children develop.

The 1996 election. At the Democratic National Convention in Chicago in August 1996, Clinton and Gore were renominated without opposition. The Republicans nominated Robert Dole of Kansas for president and Jack Kemp of New York for vice president. Ross Perot ran for president on the Reform Party ticket.

In the presidential campaign, Clinton pointed to his first-term record, emphasizing improvements in the economy and such laws as gun control measures and the minimum-wage increase. He also said he had kept Congress from cutting some government programs too deeply, including Medicare, welfare, and education. In November, the voters reelected Clinton and Gore.

Clinton's second administration (1997-2001)

International affairs. In 1998, Clinton visited China, where he urged its leaders to allow a greater degree of democracy. Also in 1998, Clinton called for increased controls on nuclear weapons after India and Pakistan tested such weapons. In August 1998, bombs planted by terrorists destroyed the U.S. embassies in Kenya and Tanzania. American officials claimed that terrorists camped in Afghanistan and led by Osama bin Laden, a wealthy Saudi businessman, were responsible for the bombings. Clinton ordered missile strikes against the camps in Afghanistan and a plant in Sudan suspected of making deadly nerve gas for terrorists.

In December 1998, Clinton ordered U.S. forces to launch missile strikes against military and industrial sites in Iraq. Clinton said he ordered the attacks because Iraq had failed to cooperate with United Nations (UN) inspection of suspected weapons facilities. UN officials feared that the Iraqi facilities contained or could be used to produce chemical, biological, or other weapons of mass destruction. Iraq had agreed to such inspections after its defeat by U.S-led forces in 1991.

In March 1999, NATO began air strikes against Yugoslavia to halt Yugoslav attacks against ethnic Albanians in Kosovo, a province of the Yugoslav republic of Serbia. The air campaign used primarily U.S. aircraft and cruise missiles. Clinton said there was no alternative to military intervention because Yugoslavia refused to halt its attacks. But in June 1999, Yugoslav military leaders agreed to withdraw their troops. NATO stopped the bombing and sent an international peacekeeping force to Kosovo. The United States pledged 7,000 troops.

In 2000, Congress passed a bill calling for permanent normal trading relations with China. Clinton had campaigned tirelessly for the bill's passage. He said that opening markets between the United States and China would not only increase jobs and prosperity in the United States but help spread democratic values abroad.

Domestic events. The Republican Party kept control of both houses of Congress as a result of the 1996 elections. In August 1997, Clinton and the Republican-controlled Congress reached a compromise on the budget. The two sides agreed to a plan to end the deficit by 2002. In 1998, however, the government beat the 2002 deadline. That year, a strong economy helped lead to a $70 billion budget surplus. The surplus was the first achieved by the federal government since 1969.

Clinton continued to appoint women and minorities to important posts. In 1996, he named Madeleine K. Albright secretary of state. Albright, who took office in 1997, became the first woman to head the Department of State. Bill Richardson, another Clinton appointee, became the first Hispanic American to serve as the head U.S. delegate to the United Nations. Norman Mineta, appointed secretary of commerce in 2000, was the first Asian American to serve in the Cabinet.

In 1994, a former Arkansas state employee named Paula Corbin Jones filed a sexual harassment suit against Clinton. Jones claimed that in 1991, when Clinton was governor of Arkansas, he had requested sexual favors from her. In April 1998, a federal judge dismissed the Jones case, ruling there was not enough evidence of sexual harassment to send the case to a jury. Jones appealed this verdict. In December 1998, while the appeal was being heard, Clinton agreed to a cash settlement for Jones, and Jones dropped the appeal.

While preparing Jones's case, her lawyers had attempted to establish a pattern of sexual affairs between the president and female employees. As part of this effort, Jones's lawyers took testimony from a former White House intern named Monica Lewinsky, whom they suspected of having an affair with Clinton from late 1995 to early 1997.

In January 1998, Kenneth Starr, who was still investigating the Whitewater case, asked Attorney General Janet Reno to expand his authority to allow him to investigate the Lewinsky matter, and Reno consented. Linda Tripp, a friend of Lewinsky's, had given Starr audiotapes on which Lewinsky reportedly discussed an affair with the president. In sworn statements to Jones's lawyers, Clinton and Lewinsky both denied having a sexual relationship.

In July, Clinton agreed to submit to questioning before a grand jury about whether he had urged Lewinsky to lie. If proven, such an action eventually could have led to criminal charges of obstruction of justice and *subornation of perjury* (persuading a witness to lie in court). Clinton testified before the grand jury on August 17. That night, he told the nation on television that he had had a relationship with Lewinsky that was not appropriate. He said it was a personal failure.

Starr sent his final report to the House of Representatives. The report suggested that Clinton may have committed impeachable offenses in trying to conceal his relationship with Lewinsky.

In December 1998, the House of Representatives impeached Clinton for perjury and obstruction of justice. The Senate then conducted a trial to consider the charges and Clinton's removal from office. In February

1999, the Senate found Clinton not guilty, and Clinton remained in office.

In October 1999, Kenneth Starr stepped down as independent counsel. One of his assistants, Robert W. Ray, took over the task of completing a final report on the Whitewater investigation. In September 2000, Ray officially ended the investigation with a statement that there was insufficient evidence to show that either of the Clintons had committed a criminal offense.

However, the possibility remained that after Bill Clinton left office, Ray would seek to bring criminal charges against him for lying under oath in the Lewinsky affair. In January 2001, just before leaving office, Clinton signed a statement in which he acknowledged that he had given "evasive and misleading answers" under oath about his involvement with Lewinsky. As a punishment, Clinton agreed to have his Arkansas law license suspended for five years and to pay a fine of $25,000.

Ray's final reports on Whitewater and the Lewinsky affair became public in 2002. The Whitewater report restated that there was insufficient evidence to show that either of the Clintons had engaged in criminal wrongdoing. In the Lewinsky report, however, Ray concluded that there was ample evidence to convict Bill Clinton of perjury and obstruction of justice. Ray declined to bring charges against Clinton in the matter, saying he believed Clinton had already been punished enough.

Later years

After Clinton left the White House, he and his wife lived in the state of New York. Mrs. Clinton had been elected in November 2000 to represent the state in the U.S. Senate. Clinton opened an office in the Harlem neighborhood of New York City. He spent much of his time traveling and giving speeches to groups and organizations. Ernest C. Dumas

Related articles in *World Book* include:

Clinton, Hillary Rodham
Democratic Party
Gore, Al
President of the United States
Starr, Kenneth Winston

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Questions

What was Bill Clinton's original name? How did he get the name?
What difficulties did Clinton have during his first term as governor?
What were Americans' main concerns when Clinton became president?
How did Clinton work to improve education in Arkansas?
As president, how did Clinton promote international trade?
Why did young Clinton become skilled at avoiding conflicts?
When did Clinton decide to pursue a political career?
How did Clinton campaign in his presidential races?
As president, how did Clinton support gun control?
Why was Clinton impeached by the U.S. House of Representatives? What happened in the Senate?

Additional resources

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Maraniss, David. *First in His Class: A Biography of Bill Clinton.* Simon & Schuster, 1995.
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Clinton, De Witt (1769-1828), an American statesman, promoted the building of the Erie Canal. As early as 1809, he advocated building the canal. Clinton served as a canal commissioner during the early years of its construction. The canal was completed in 1825, while Clinton was governor of New York. See Erie Canal.

Clinton was born on March 2, 1769, in Little Britain, New York. He graduated from Columbia College and then studied law. He served as private secretary to his uncle, George Clinton, then governor of New York. He developed a strong interest in politics. In 1797, he was elected to the State Assembly, and in the following year, he served in the state Senate.

In 1802, Clinton was sent to the United States Senate to fill a vacancy. The next year, he resigned his seat to become mayor of New York City. He was mayor from 1803 to 1815, except for two short intervals when he served in the New York Senate and was lieutenant governor of the state. In 1812, Clinton was an unsuccessful candidate for president of the United States. He served as governor of New York from 1817 to 1822 and from 1825 to 1828. He died on Feb. 11, 1828. Richard E. Ellis

Clinton, George (1739-1812), an American statesman and soldier, served as vice president of the United States from 1805 until his death. He served under two different presidents, Thomas Jefferson and James Madison. Only one other vice president, John C. Calhoun, shares this record.

Clinton also served as the first governor of New York. He was elected in 1777 after New York's constitutional convention and won reelection six consecutive times, serving until 1795. He was reelected again in 1801 and served until 1804. Clinton believed in states' rights and opposed New York's ratification of the Constitution of the United States. Under the name "Cato," he published several letters against adoption of the Constitution. The American statesman Alexander Hamilton started *The Federalist* papers largely to answer Clinton's objections.

Clinton was born on July 26, 1739, in Little Britain, New York. He was a brigadier general in the Continental Army in 1777. He was elected to the New York Assembly in 1768 and the Continental Congress in 1775. He died on April 20, 1812. A statue of him represents New York in the U.S. Capitol. Richard D. Brown

See also Vice President of the U.S. (picture).

Clinton, Sir Henry (1738?-1795), served as commander in chief of the British Army from 1778 to 1781, during the Revolutionary War in America. He retreated from Philadelphia to New York and stayed there about two years. Then, in 1780, he invaded South Carolina and captured Charleston. He returned to New York, leaving Lord Cornwallis in command in the South. After Cornwallis surrendered in 1781 at Yorktown, Clinton resigned. He was unfairly blamed for Cornwallis's defeat. Clinton was born in Newfoundland (now Newfoundland and Labrador) in about 1738 and died on Dec. 23, 1795.

See also Cornwallis, Charles. Paul David Nelson

Clinton, Hillary Rodham (1947-), a Democrat, was elected in 2000 to represent New York in the United States Senate. Before being elected a senator, Mrs. Clinton, the wife of President Bill Clinton, was one of the most active first ladies in U.S. history. She is the only first lady ever elected to public office.

In 1993, Mrs. Clinton was the chief author of a Clinton administration plan to guarantee low-cost health care to all Americans. Congress chose not to act on the plan. Many people thought the plan would give the government too large a role in the health care system. But in 1996, Congress passed a bill that included key elements of the plan (see **Clinton, Bill** [National affairs]).

Mrs. Clinton was born Hillary Diane Rodham in Chicago on Oct. 26, 1947, and grew up in the Chicago suburb of Park Ridge. She graduated from Wellesley College in 1969. In 1973, she earned a law degree from Yale University, where she met fellow student Bill Clinton.

In 1974, Rodham joined Clinton on the faculty of the University of Arkansas Law School in Fayetteville. She married Clinton in 1975. The couple had one daughter, Chelsea.

In 1977, she joined the Rose Law Firm in Little Rock, Arkansas. She was with the firm until 1992, when her husband was elected president.

Mrs. Clinton became a key adviser in all of her husband's political campaigns. She helped devise some of his major programs while he was governor of Arkansas from 1979 to 1981 and from 1983 to 1992. In the early 1980's, for example, Mrs. Clinton played a leading role in reforming the public school system in Arkansas.



The White House

Hillary Rodham Clinton

Mrs. Clinton developed a deep interest in problems faced by neglected children. From 1986 to 1992, she served as national chairperson of the Children's Defense Fund, an organization that promotes child welfare. Her book *It Takes a Village* (1996) calls for community participation in helping children develop.

In 1999, Senator Daniel P. Moynihan of New York announced that he would not seek reelection in 2000. In February 2000, Mrs. Clinton declared that she was a candidate for Moynihan's seat in the Senate.

Ernest C. Dumas

Clipper ship was a fast, slender sailing vessel that was developed in the United States in the mid-1800's. To be classed a clipper, a ship needed a narrow *hull* (body) deeper in the back than at the front, and many large sails mounted on tall *masts* (sail poles). Clipper ships were modeled after the "Baltimore Clippers," small, swift sailing ships developed on Chesapeake Bay for sea use.

The name *clipper* came from the way the ships "clipped off" the miles. Traders used clipper ships to bring tea and opium from China, and wool and gold from Australia. Clipper ships carried passengers across the Atlantic Ocean, and around Cape Horn to California during the gold rush of 1849-1857.

The *Rainbow,* designed by the American naval architect John W. Griffiths and launched in 1845, was the first true clipper ship. It was much larger and faster than the

Color lithograph (1853) by Nathaniel Currier (Granger Collection)



The ***Great Republic,*** a clipper ship, was the largest sailing vessel in the world when it was launched in 1853. The ship measured about 335 feet (100 meters) long. The slender hulls and many sails of the graceful clippers made the ships the fastest vessels of the mid-1800's.

earlier "Baltimore Clippers." Other famous clipper ships included the *Sea Witch* and the *Cutty Sark.* Perhaps the most famous builder of clippers was Donald McKay, a Canadian. McKay did most of his work in East Boston. His ships included the *Flying Cloud, Stag Hound, Lightning, Sovereign of the Seas,* and *Great Republic.*

Typical fast clipper trips included a voyage across the Atlantic Ocean in 12 days 6 hours by the *James Baines,* and a run of 465 nautical miles (862 kilometers) in 24 hours by the *Champion of the Seas* in 1854. More than 25 years passed before a steamship beat the record set by *Champion of the Seas.*

The opening of the Suez Canal between the Mediterranean and Red seas in 1869 did away with the need for clippers for the tea trade. Many clippers began carrying wool from Australia, but in this trade, speed was not essential. Thus, in the late 1800's, *square-riggers* (ships designed to carry larger cargoes at slower speeds) gradually replaced the clipper ships. James C. Bradford

See also **Ship** (Clipper ships).

Clive, Robert (1725-1774), was the British administrator and military leader who brought India into the British Empire.

Clive was born on Sept. 29, 1725, in Shropshire, England. He joined the English East India Company, Britain's trading company in India, in 1743. In 1747, he received a commission in the company's armed services. The British and French trading companies were struggling for control of India, and Clive won several important victories over the French and their Indian allies. In 1757, he led 3,200 troops to victory over 50,000 enemy troops at the Battle of Plassey. This victory enabled the British to gain control of Bengal, the richest province in India.

Clive returned to Britain in 1760 and entered Parliament. He was named Baron Clive of Plassey in 1762. In 1773, some of Clive's enemies persuaded Parliament to investigate his career in India. The investigation showed that Clive had made a fortune, but that he had also rendered "great and meritorious service to his country." Sickness during the last year of his life caused Clive to become an opium addict. He committed suicide on Nov. 22, 1774. Brijen K. Gupta

Clock is an instrument that shows the time. The first clocks were probably developed in the late 1200's. They had no hands or dial but told time by ringing a bell. The word *clock* probably comes from the French word *cloche* and the German word *Glocke,* both of which mean *bell.*

Kinds of clocks

Modern clocks range from small, inexpensive models to large, ornamental grandfather clocks with beautiful wood cases. Traditional clocks, called *dial clocks,* have hands that show the time by pointing to numbers on a dial. Other clocks, called *digital clocks,* show the time in digits on the clock face. Many clocks have chimes or sound an alarm. Others have dancing figurines that mark the hours or other intervals of time.

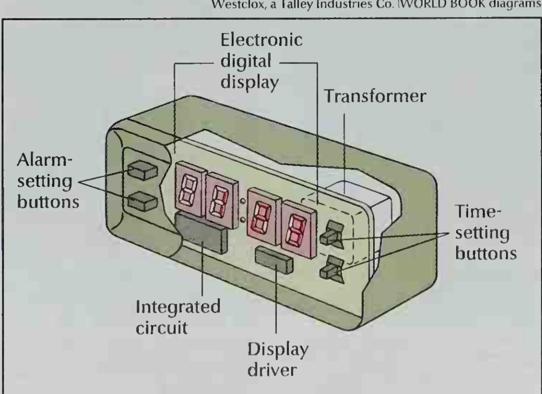
Every clock has two main parts, the *case* and the *works,* or *movement,* inside the case. The works performs three functions. In addition to showing the time, it supplies power to run the clock and it keeps time. Clocks differ according to how their works carry out one or more of these three functions. This article classifies clocks into two groups, *mechanical clocks* and *electric clocks,* according to how they are powered.

Timekeeping in most clocks is based on the frequency of some regularly repeated action, such as the swing of a pendulum. Clocks with extremely stable frequencies keep time more accurately than those with less stable frequencies. For example, the operation of atomic clocks, the most accurate clocks ever made, is based on the vibrations of certain atoms and molecules. Each particle has a natural characteristic frequency that is ex-

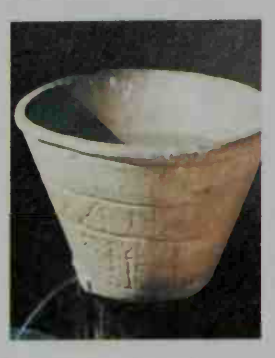
A weight-driven clock, *left,* is powered by a weight that is lowered from a drum, *shown in green.* As the weight descends, the drum revolves and turns gear wheels, *pink,* that move the hands. The pendulum and escapement, *orange,* control the clock's speed.

A line-powered digital clock, *below,* is powered by an alternating electric current. The current flows through the transformer to the integrated circuit, which changes the current's frequency into timed electric impulses. The display driver makes these impulses strong enough to run the electronic display.

Westclox, a Talley Industries Co. (WORLD BOOK diagrams)



Some historical clocks



An Egyptian water clock from about 1400 B.C. is shown above. As water drains away, dots inside the pot measure the water level and tell how much time has passed.



A sundial uses the sun's motion across the sky to tell time. The sun casts a shadow that moves across the dial and points to the hours. This sundial is from the 1100's B.C.



Early mechanical clocks were weight driven and had only one hand. Some had a bell that struck the hours. This clock was made in Germany during the late 1400's.



Early portable clocks were powered by a coiled mainspring. Many such clocks had a separate cover, *above left.* This clock was made in France during the mid-1500's.



Pendulums for clocks were developed during the mid-1600's. These devices greatly improved timekeeping accuracy. This Dutch pendulum clock dates from the 1650's.



Time Museum, Rockford, Ill. (WORLD BOOK photos)

Marine chronometers are clocks designed especially for use in navigating the sea. This chronometer is one of the first ones built. It was made in England in 1777.

tremely stable. As a result, the best atomic clocks would not lose or gain more than a second in 1 million years.

Mechanical clocks are powered by various mechanical devices that must be wound at various intervals. Some have to be wound every day, but others can run for seven or eight days without rewinding. There are two main kinds of mechanical clocks, *weight driven* and *spring driven.* Almost all of them are dial clocks.

Weight-driven clocks are powered by a heavy weight that hangs from a cord or chain. When the clock is wound, the cord or chain gets wrapped around a drum and draws the weight up near the drum. As gravity pulls the weight down, the cord or chain slowly unwinds and turns the drum. This action of the drum turns a number of gear wheels that are connected in a series called the *train.* The hands of the clock are attached to individual wheels in the train. Each of these wheels turns at a specific speed. A pendulum and a mechanism called the *escapement* prevent the weight from being lowered too fast. They also regulate the clock's speed.

The escapement includes an *escape wheel* and a *verge.* The escape wheel is connected to the train and turns when the clock runs. The pendulum, which is the timekeeping device of the clock, swings from side to side at a steady rate. As the pendulum swings, it tilts the verge from side to side. With each tilt, two hooks called *pallets*—one at each end of the verge—catch on the escape wheel and stop it. When the pendulum swings back, the pallets release the wheel, and the wheel turns slightly. This process regulates the speed of the escape wheel and of the wheels in the train. It also causes the tick-tock sound of the clock.

Spring-driven clocks contain a coiled spring called



Robert Frerck, Odyssey Productions

Human figures decorate a clock at the Church of Our Lady in Nuremberg, Germany. The figures are mechanical, and they perform a pageant daily at noon. Nuremberg was a clockmaking center in the 1500's and 1600's.

the *mainspring.* This spring gets wound up when the clock is wound. Then the mainspring unwinds slowly, turning the wheels in the train.

The escapement in a spring-driven clock resembles that of a weight-driven clock. However, many spring-driven clocks have a *balance wheel* instead of a pendulum as the timekeeping device. A coiled spring called the *balance spring,* or *hairspring,* is connected to the balance wheel. This spring coils and uncoils and makes the balance wheel swing back and forth at a fixed rate. The swinging motion causes the verge to tilt. The pallets alternately catch and release the escape wheel and regulate the speed of the train.

Electric clocks can be *battery powered* or *line powered.* A line-powered clock receives power from an electric outlet. Almost all digital clocks manufactured since the 1930's have been electric models.

Battery-powered clocks. Many battery-powered clocks have a balance wheel or a pendulum. Others have a miniature tuning fork or a tiny bar of quartz crystal. The battery activates the tuning fork or crystal, which vibrates with high, steady frequencies. In clocks with a tuning fork, an *indexing mechanism* changes the number of vibrations into the correct speeds for the gear wheels. In quartz-based clocks, an electric circuit translates the number of vibrations into time information.

Line-powered clocks. In line-powered clocks, the current from the electric outlet not only supplies power but also regulates the clock's speed. The outlet supplies *alternating current* (current that reverses its direction). Current supplied in most parts of the United States and Canada reverses its direction 120 times every second. In some clocks, a motor counts the changes in direction and uses that information to control the time display. In other clocks, this function is performed by a *computer chip,* a complex electronic circuit built into a tiny piece of silicon. See **Computer chip; Electric current** (Direct and alternating current).

Most digital clocks are line powered. In some, the digits are printed on flip cards, rotating drums, or a moving tape. Other line-powered models and some quartz-based clocks have electronic digital displays, such as a *liquid crystal display* (LCD) and a *light-emitting diode display* (LED). A liquid crystal display uses digits that reflect the light around it. A light-emitting diode display has digits shaped from electronic devices called *diodes,* which give off light.

History

Sundials, which were developed more than 4,000 years ago, are the oldest known instruments designed for telling time. As the sun crosses the sky, it casts a shadow on the dial. A sundial tells time by measuring the length or the angle of the shadow. See **Sundial.**

Other early timekeeping devices included hourglasses and water clocks. In these devices, sand or water flowed from one container into another at a steady rate. By measuring the material in either container, people could tell how much time had passed. See **Hourglass; Water clock.**

The first mechanical clock was probably invented in China in the late 1000's. However, this invention was never developed further, and later Chinese clocks were based on European models.

The first mechanical clocks in Western civilization were developed by a number of inventors during the late 1200's. These clocks were weight driven, but they had no pendulum or hands. A bell rang to indicate the hour. By the mid-1300's, the dial and hour hand had been added. The first spring-driven clocks were probably developed in Italy during the late 1400's.

Most early clocks ran unevenly and inaccurately. The pendulum and the balance spring, which were developed during the mid-1600's, greatly improved timekeeping accuracy. Minute and second hands became common. By the mid-1700's, inventors had developed most of the mechanisms found in modern mechanical clocks.

Electric clocks, introduced in the mid-1800's, were in many homes by the 1920's. Quartz-based clocks appeared during the 1930's, and scientists developed the first atomic clock in the 1940's. Digital clocks became popular in the 1970's, particularly as wrist watches. In the 1980's, the computer chip was incorporated into clock mechanisms. Besides displaying the time, watches with chips can store information, and serve as calculators and miniature game boards. James Jespersen

Related articles in *World Book* include:

Atomic clock	Chronometer	Pendulum
Banneker, Benjamin	Hour	Time
	Minute	Watch

Cloister, *kloys tuhr,* in architecture, refers to a covered walk that encloses the courtyard of a monastery, convent, church, or college. Columns along one or more sides support the roof. The term *cloister* can also refer to the courtyard itself or to any place of religious seclusion. The word comes from a Latin word that means *a closed-off space.*

Both architecturally and symbolically, the cloister unifies the monastery. An *oratory* (small chapel) or church usually opens off one side of the cloister. Common rooms and private rooms open off the other three sides. Many cloisters contain a garden and a fountain or well, and are used for work and recreation as well as for walkways. Cloisters are also sometimes used as graveyards for monks and notable associates of the monastery. See **Monasticism** (picture).

Beginning in the late 700's, the cloister became an important part of a monastery. Gradually, cloisters were



Robert Frerck, Odyssey Productions

A cloister is a covered walk that encloses a courtyard. Most cloisters are part of a church, convent, monastery, or college. This Romanesque style cloister is part of a monastery in Spain.

added to other religious institutions and to colleges. In England, for example, Westminster Abbey, Oxford University, and Eton College have impressive cloisters.

The Roman Catholic Church established what is known as the *rule of cloister.* The current rule states that all houses of religious orders must have an enclosure appropriate to the order's character and ministry and reserved only for members. Religious orders whose ministry is primarily prayer and meditation require a stricter observance than do orders engaged in active ministry in the outside world. David G. Schultenover

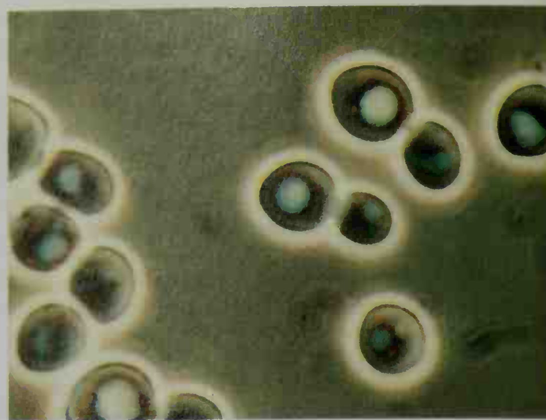
Clone is the name for a group of organisms or other living matter with exactly the same *genetic material.* Genetic material consists of *genes,* the parts of cells that determine characteristics in living things.

Many examples of clones exist in nature. In human beings and other higher animals, clones form naturally when identical twins or other genetically identical multiple births occur. Single-celled organisms, including bacteria, protozoa, and yeast, produce genetically identical offspring through *asexual reproduction.* These offspring develop from only one parent and are considered clones. Plants can also reproduce asexually through a process called *vegetative propagation.* In this process, a piece of root or stem can generate a new plant that is genetically identical to the donor plant. Vegetative propagation helps people obtain plant clones with desired traits. For example, farmers and breeders use it to develop apples with unique flavors or roses of certain colors.

Scientists produce many examples of clones in biological research laboratories. For instance, biologists can isolate individual cancer cells and enable them to reproduce to form cell colonies. These colonies consist of many clones of the original cancer cell. Laboratory scientists also develop clones of the chemical substance *DNA (deoxyribonucleic acid).* DNA occurs in every living cell and often contains thousands of genes. Scientists use DNA cloning techniques to reproduce specific genes. These techniques commonly involve *plasmid DNA,* which occurs in certain bacteria and can reproduce easily. Scientists first isolate a DNA fragment containing a particular gene. They then combine the DNA fragment with the *plasmid DNA* to form *recombinant DNA.* Because the plasmid DNA reproduces easily, the new recombinant DNA can also replicate easily. Thus, scientists can generate large quantities of the recombinant DNA and the particular gene of interest.

Cell cloning and DNA cloning have revolutionized the fields of biology and medicine. They have helped people acquire a better understanding of the structure and function of cells and genes. Cloning techniques enable scientists to better study defective genes in cancer cells and other mutant cells. Such studies, in turn, help us learn more about the function of these genes in normal cells. They also can help scientists discover the genetic causes of many diseases, thus enabling doctors to better diagnose and possibly cure these illnesses.

Since the mid-1900's, scientists have developed an experimental technique for cloning higher animals. This process first involves destroying the nucleus of an egg cell from the species to be cloned. A nucleus is then removed from a cell of an animal of the same species and injected into the egg cell. The egg, with its new nucleus, develops into an animal with the same genetic makeup



Anheuser-Busch, Inc.

Yeast cells form clones when they reproduce. Each cell divides to create a genetically identical cell.

as the donor. If a number of eggs receive transplants from the same donor, the offspring are considered clones of the donor animal.

Scientists used this technique to clone such amphibians as frogs and salamanders as early as the 1950's. In 1996, a group led by the British scientist Ian Wilmut used the procedure to clone a sheep. They named the clone "Dolly." The event marked the first time a mammal had been cloned in this way. Since the cloning of Dolly, scientists from Japan, the United States, and elsewhere have used a similar technique to produce clones of mice, cattle, and other mammals.

Improvements in cloning technology may yield important benefits to people. Cloning of such animals as cattle or sheep could enable scientists to create genetically superior livestock. These livestock would produce higher quality meat, milk, and wool. A few scientists have begun cloning human embryos to produce *stem cells*—that is, cells that can develop into many different types of cells. This kind of cloning is known as *therapeutic cloning* because doctors might be able to use the stem cells to replace damaged human tissues and treat diseases.

Cloning presents problems, however. Mammal cloning techniques have not been perfected, and scientists have found it difficult to produce consistently healthy clones. Moreover, scientists soon may be able



AP/Wide World

The first cloned kitten sits next to its *surrogate mother,* the cat that gave birth to it. The kitten is a clone of another cat. Scientists created the cloned kitten in 2001 by producing an embryo from the genetic material of an adult female cat. They then inserted the embryo into the surrogate mother.

to use cloning techniques to reproduce human beings. Most people regard such cloning as unethical or against their religion's principles. Many also object to therapeutic cloning on ethical or religious grounds. These concerns have prompted numerous countries to ban both types of human cloning. Peter Burbelo

See also **Genetic engineering; Multiple birth; Plant** (Vegetative propagation); **Regeneration; Reproduction.**

Close, Chuck (1940-), is an American artist known for his large-scale portraits. He began painting highly realistic portraits about 1967, working from photographs in a slow, painstaking method. Close enlarged a photograph onto a canvas as large as 8 feet (2.4 meters) high. He painted with a tiny airbrush and acrylic paint, which created detailed images and a totally smooth surface.

Close's earliest images omitted color and expression. Their passive quality resembled a photo on a driver's license or a passport. But their monumental size created an imposing, haunting effect. See **Painting** (People).

In the 1970's, Close expanded his mediums to include water color, ink, pastel, oil paint, and printmaking. He maintained the passive quality and photographic nature of his images, but began to loosen their structure. Close even began painting with his fingers and creating *collages* (images made by gluing bits of paper and other materials to the canvas) with handmade paper chips.

In December 1988, Close suffered a collapsed artery in his spine that left him paralyzed from the shoulders down. However, he continued to paint and produced many critically acclaimed portraits during the 1990's.

Charles Thomas Close was born on July 5, 1940, in Monroe, Washington. He received a Bachelor of Fine Arts degree in 1963 and a Master of Fine Arts degree in 1964, both from Yale University. Deborah Leveton

Closed captioning is a system that presents the dialogue and sound effects of television programs and prerecorded movies as text on a television screen. It thus enables viewers who are deaf or hearing-impaired to better enjoy television broadcasts and movies. It also serves as an educational tool for people learning English as a second language. Closed captioning came into use in 1980 in the United States and 1981 in Canada.

Closed captioning information is stored in a portion of the TV signal that does not make up part of the ordinary picture and sound. Captions appear on the screen when special circuitry in a television set, or in a separate device, is activated, usually via remote control.

For videotapes, DVD's, and prerecorded television programs, captions are typed into a computer and *encoded* (added to the signal) before broadcast. Live broadcasts, which are shown as they happen, are typically captioned by a skilled typist called a *stenocaptioner* typing on a shorthand machine. A computer translates the shorthand and encodes the captions.

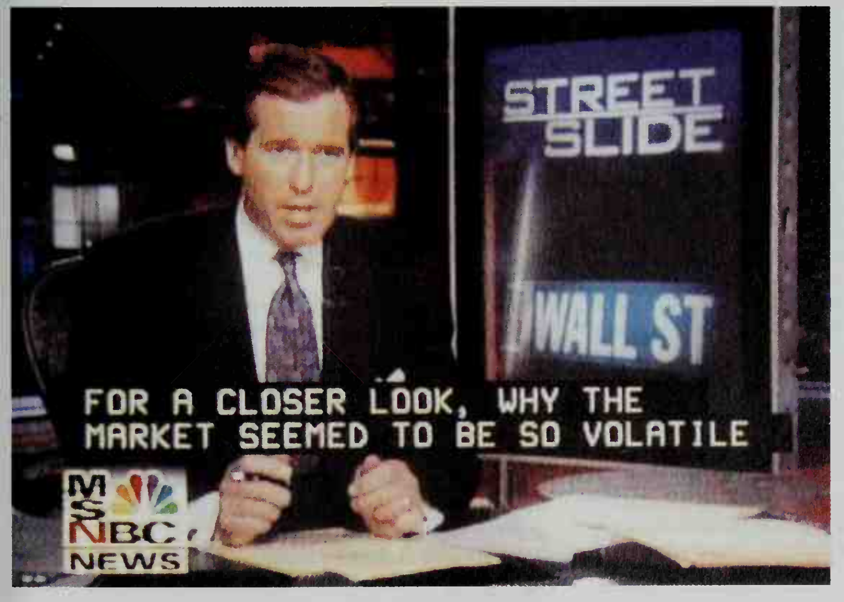
Two major laws affect captioning in the United States. The Decoder Circuitry Act of 1990 requires most television sets made after July 1993 to have the ability to display captions. The Telecommunications Act of 1996 requires broadcasters to add captions to an increasing number of programs. Under this act, all programs must be captioned in English by 2008 and in Spanish by 2012. Since the early 1990's, the Canadian Radio and Television Commission has required Canadian broadcasters to increase their use of closed captioning.

Gary D. Robson

Closed shop is a workshop or an industry in which only members of a labor union may be hired. In some closed shops, the union supplies all of the employees. When new employees must be hired, the employer obtains them through a union. Closed shops differ from *union shops.* A union shop may hire nonunion employees, but they must join the union soon after they have been hired. The closed shop was declared illegal by the Taft-Hartley Act of 1947. However, the union shop is not illegal. See also **National Labor Relations Act; Open shop; Taft-Hartley Act; Union shop.** Daniel Quinn Mills

Closure. See **Cloture.**

Cloth. See **Textile.**



Closed captioning enables people with hearing loss to understand dialogue on television. A decoding device inside a TV set uses information in the television signal to generate a caption that appears on the screen.





© R. Michael Stuckey, Comstock

Shopper in the United States



Design Photographers International

Inuk (Eskimo) in Alaska




Bruno Barbey, Magnum

Masai people in Kenya

D. Seymour, Magnum

Bullfighters in Spain

W. King, FPG

Women in Morocco

Clothing is one of people's most important needs. Most people wear some kind of garments, accessories, or ornaments. People in different parts of the world wear many different types of clothes. This variety occurs because individuals have different purposes for wearing clothes, use different materials and methods for making clothes, and follow different clothing customs.

Clothing

Clothing includes all the different garments, accessories, and ornaments worn by people throughout the world. A person who lives in an Arctic region may wear boots, warm pants, and a heavy coat. An African in a village may wear only a piece of cloth tied around the waist. A nurse may wear a white uniform, cap, and shoes. A London banker may wear a business suit and a hat. Each of these persons dresses differently, but they all feel a need to wear some kind of clothing. Like food and shelter, clothing is one of people's most important needs.

Throughout history, many people have worn clothing more for decoration than for covering the body. Even in cold climates, some people seem more interested in decorating their bodies than in protecting them. In the 1830's, for example, the famous British biologist Charles R. Darwin traveled to the islands of Tierra del Fuego, off the southern tip of South America. There he saw people who wore only a little paint and a small cloak made of animal skin, in spite of the cold rain and the sleet. Darwin gave the people scarlet cloth, which they took and wrapped around their necks. Even in the cold weather, these people wore clothing more for decoration than for protection.

No one knows exactly why or when people first wore clothes. But they probably began to wear clothing more than 100,000 years ago—and probably for much the same reasons we wear clothes today. Early people may have worn clothing to protect themselves, to improve their appearance, and to tell other people something about themselves. For example, a prehistoric hunter may have worn the skin of a bear or a reindeer in order to keep warm or as a sign of personal skill, bravery, and strength in hunting.

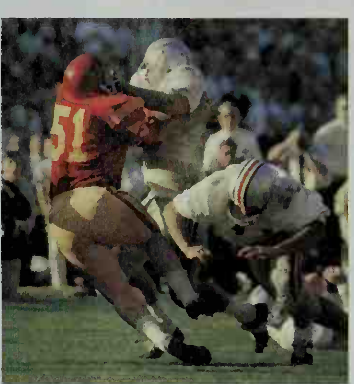
By the end of the Old Stone Age—about 25,000 years ago—people had invented the needle, which enabled

Richard Martin, the contributor of this article, is former Curator of the Costume Institute at the Metropolitan Museum of Art in New York City.


Marilyn Silverstone, Magnum
Women in India


Van Bucher, Photo Researchers
Schoolchildren in Japan


Camera Press, Pix
Ballet dancers in Russia



WORLD BOOK photo by Lee Balterman
Football players in the United States

Björn Bölstad, Photo Researchers
Colorado Indian in Ecuador

them to sew skins together into clothing. They had also learned to make yarn from the threadlike parts of some plants or from the fur or hair of some animals. In addition, they had learned to weave yarn into cloth. By this time, people had begun to raise plants that gave them a steady supply of materials for making yarn. They had also started to herd sheep and other animals that gave them wool. These few advances took thousands of years. Most changes in the ways of making clothing and in the materials used for clothing have come only during the last few hundred years.

Until about 200 years ago, people had no machines for making clothes. Most families made their own clothing. Sometimes businesses paid groups of workers to make clothes, which the businesses then sold. But most of the people who made clothes worked at home. There were no clothing factories.

During the late 1700's and 1800's, the invention of several machines brought the clothing industry out of the home and into the factory. Machines that could spin thread, weave cloth, and sew clothes led to the growth of the clothing industry. Today, people in most parts of the world can buy ready-to-wear garments made in large clothing factories.

The clothing industry is a giant business in many countries. Clothes and clothing materials are important items of trade between nations. Shoppers in many lands buy Italian knitwear and shoes, Australian wool, and Japanese silk. Stores throughout the world sell clothes designed in London, Paris, and Milan. As a result, many people in different countries—especially people who live in cities—wear similar clothes. But there are still differences in dress among most regions of the world.

People in various regions dress differently for many reasons. They may need protection from different kinds of weather. They may have different materials and methods for making clothes, or they may have different habits of dress.

This article discusses why people wear clothes, describes clothing around the world, and traces the history of clothing. Then it describes the clothing industry and tells of career opportunities in the industry. For further descriptions of the clothing worn by various peoples, see the many country articles in *World Book.*

Why people wear clothes

Most people, no matter where they live, wear some kind of clothing. Any person may wear certain clothing for a variety of individual reasons. But in general, people wear clothes for three main reasons: (1) protection, (2) communication, and (3) decoration. Most clothing serves all three purposes.

Protection. Clothing helps protect people's physical and emotional health.

Physical protection. People have probably worn clothing for physical protection since they first put on animal skins, leaves, or other clothing materials. In many areas of the world, people need clothing for protection from the weather. Clothing also protects people who work on dangerous jobs, take part in rough sports, or engage in other hazardous activities.

In cold climates, people wear warm garments made of wool, fur, or closely woven fabrics. They also wear warm shoes or boots.

In warm climates, people wear clothes made of such lightweight materials as cotton or linen, which have a fairly open weave. These materials absorb perspiration and allow air to flow around the body. People in these climates sometimes wear white or light-colored clothes because such colors reflect the sun's rays. They may also wear sandals, which are more comfortable than shoes or heavy boots in warm weather. Large hats made of straw serve as sunshades.

In many places, people must wear clothes for protection against several kinds of weather. For example, people of the Arabian deserts wear loose, flowing garments that shield their bodies from the blazing sun. The same garments protect them against the cold night air. Even in less severe climates, people may require protective clothing during the hot and cold seasons.



NASA

Astronauts wear protective clothing. The space suit worn by astronauts on the moon protected them from heat and cold. It also provided an artificial atmosphere in which they could live.

Certain activities require special protective clothing. A soldier in combat wears a steel or plastic helmet and a nylon vest lined with plastic sheeting or fiber glass. Welders wear protective shields over their faces. Astronauts wear special suits and helmets for protection against changes of air pressure and temperature. Factory workers wear heavy shoes to protect their feet. Football players wear padded equipment to guard against injury.

In some societies, people may wear clothing for protection against unusual types of physical harm. For example, people in France wore plain clothes during the French Revolution in the late 1700's. Revolutionaries might have thought that people wearing fancy clothes belonged to the upper class, and they would probably have killed them. In some countries, people believe that evil spirits can cause bodily harm. These people may wear special clothes that they think have magic power to deal with such spirits.

Emotional protection. Clothing protects people's emotional health by helping satisfy some of their needs. For example, most people need to feel they are accepted as members of society or of some special group. Many persons also want to feel they are independent individuals—different in at least some small way from everyone else.

People who want to belong to a certain group usually dress in a style similar to that of people in the group. Through their choice of clothes, they tell members of the group that they share their attitudes, beliefs, and way of life. People who want to show their independence may wear different styles of clothing from that worn by others. By wearing such clothes, they seem to say, "Look at me. I am someone special."

Communication. People communicate by means of the clothes they wear. Their clothes may tell others who they are, what they are like, how they feel, and what they would like to be.

Who people are. People can identify some famous individuals, such as the President of the United States or a well-known actor, without looking at their clothes. However, few individuals are so well known. In most cases, a glance at a person's clothes helps people identify the person.

Clothing may reveal such facts as a person's occupation, approximate age, and sex. Bus drivers, mail carriers, nurses, police officers, and priests wear special clothing to help other people know what they do. People of different ages usually dress differently, and men and boys dress differently from women and girls. Some types of dress or uniforms show that a person belongs to a certain group. For example, Boy Scouts and Girl Scouts wear special uniforms.

What people are like. Clothes tell something about people's beliefs and feelings, their personality, and their general approach to life. Confident people often show more independence in choosing their style of dress



Boy Scouts of America

A uniform is the distinctive clothing that identifies a person as a member of a certain group or organization. For example, this boy's uniform shows that he is a Boy Scout.

than does someone who is shy or unsure of himself. The confident individual is likely to try new clothing styles. A shy person may seek security by following current styles. Others may be unconcerned about their dress and care little whether they dress in what others consider attractive clothing.

Some people wear plain clothes because of strong beliefs about personal behavior. These people believe it is wrong to care about wearing clothes as decoration. They believe that, instead, people should be concerned with other matters. Members of the Amish religious group have this kind of belief. Amish men wear plain, dark clothes, and Amish women wear long, plain dresses.

How people feel. Clothing often helps communicate the mood of a person. People who are sad or upset may show little concern for their appearance. Clothing with bright colors and bold designs may indicate happiness. Such clothing may even brighten the mood of others who see a person wearing it.

In many societies, clothing of certain colors has special meaning. For example, people in mourning may wear black clothes. But colors may have different meanings in various societies. A color worn for weddings in one country may be worn for funerals in another land. Most brides in the United States wear white gowns. But the people in India wear white clothes to mourn the dead.

What people want to be. People often wear clothes that they think make them appear a certain way. People may dress to hide their feelings or their age, or they may dress like people in some occupation. A person who feels sad may wear bright clothes to hide this mood from others. Many children enjoy wearing the clothes of their mother or father to "play grown-up." A person entering show business may imitate the dress of some entertainer whose success is established. When applying for jobs, many people wear clothes that they think make them look older or younger than their real age. They may also dress as they think people holding a certain job should look.

Decoration. Most people want to wear clothing that makes them feel attractive—even if its chief purpose is protection or communication. Such protective clothes as raincoats, snow boots, and sweaters come in bright colors and bold patterns. Even military uniforms are designed to improve the appearance of servicemen and servicewomen.

Many people accept frequent changes in clothing styles because they want to appear attractive by wearing the latest fashions. A woman may stop wearing an old coat that is still in excellent condition. She does so because she feels it no longer makes her so attractive as does a new style of coat.



Jack Fields, Photo Researchers

A ceremonial costume is probably worn more as decoration than as covering by this man in New Guinea. Decoration is one of the chief reasons most people wear clothing.

Clothing around the world

For thousands of years, people in different parts of the world have worn different types of clothes. Today, the Western style of clothing—common in the United States, Canada, and Europe—has spread throughout the world. But the clothing worn by different peoples still varies widely, especially among people who do not live in cities.

Why clothing varies. There are four main reasons for worldwide variety in clothing: (1) differences in the purposes for wearing clothes, (2) differences in the materials available for making clothes, (3) differences in ways of making clothes, and (4) differences in clothing customs. These differences result in clothing variety from continent to continent, from country to country, and even from person to person.

Purpose. As we have seen, people wear clothes for three basic purposes—protection, communication, and decoration. But people in various regions of the world often need different kinds of protection, especially if they live in different climates. People may also wear clothes that have a special meaning not understood by people of other countries. For example, many Muslim women wear veils in public because their religion requires them to hide their faces from strangers. In addition, people have different ideas about what makes clothing attractive.

Different purposes for wearing clothes cause much of the worldwide variety in clothing styles. People wear clothes for various kinds of protection. They also wear clothes to communicate with other people and to decorate themselves. The pictures in the first row below show examples of clothing worn for protection in different climates. The pictures in the second row show examples of garments worn in various countries for communication and for decoration.

Clothing in hot climates



David Moore, Black Star
Boy in American Samoa



Berko, DPI
Old man in Mexico

Clothing in cold climates



Paolo Koch, Rapho Guillumette
Russian family in Moscow

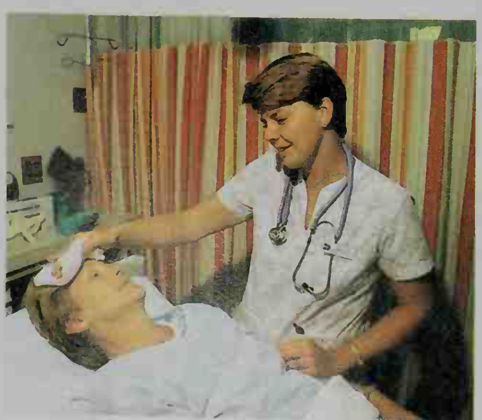


George Holton, Photo Researchers
Sami family in Finland

Clothing for communication



Sabine Weiss, Rapho Guillumette
Chef in France




© Comstock
Nurse in the United States

Clothing for decoration



Dennis Stock, Magnum
Geishas in Japan

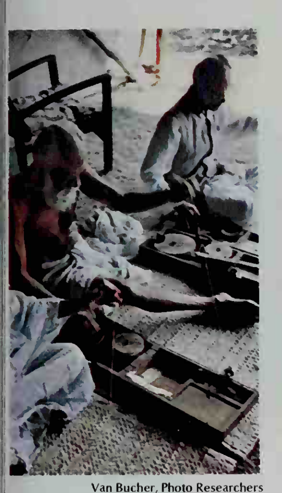
Available materials. People in different countries may have different materials available for making clothes. For example, the people of France can wear clothes made from a much greater variety of materials than can the people of China. French stores sell garments made not only of such natural materials as cotton, fur, leather, silk, and wool, but also of such artificially made fibers as nylon and rayon. Most people in China must choose clothing made of cotton.

Ways of making clothes vary from country to country. Highly industrialized nations, such as Canada, Japan, and the United States, use many kinds of machines and a variety of processes to make clothes. For example, textile manufacturers in those countries can rapidly produce yards of cotton cloth woven many different ways. These textile manufacturers can also dye the cloth and rapidly sew it into different kinds of clothes.

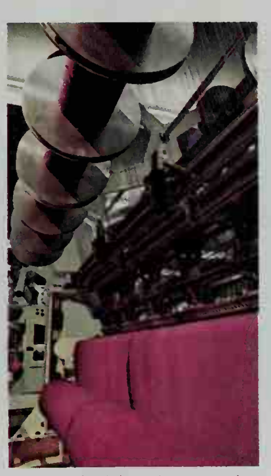
People living in a village in India may have only hand-powered equipment for weaving cloth. They may create a variety of designs—maybe more than a machine can—but they need much more time than a machine to make the cloth. They would also have to sew their clothes by hand.

Clothing customs affect styles. These customs develop in a country as generation after generation of children learns what clothes to wear. For example, a Mexican farmer and a Chinese farmer may wear clothes made from similar materials and by the same basic methods. They also may need their clothes for the same purpose. But the custom in Mexico is to wear straw hats with brims that tilt up. In China, custom calls for straw hats with brims that slant down.

Different materials and methods for making clothes produce differences in clothing styles. Cotton clothes, for example, look much different than clothes made of plastics. The pictures below show some of the materials and methods used in various countries for making clothes.



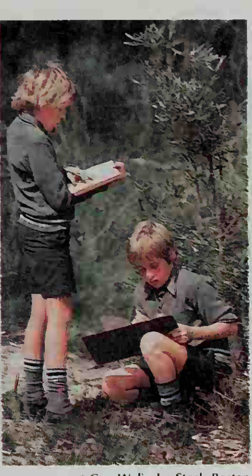
Van Bucher, Photo Researchers
Spinning cotton in India



Frederick de Van from Nancy Palmer
Power loom in the U.S.



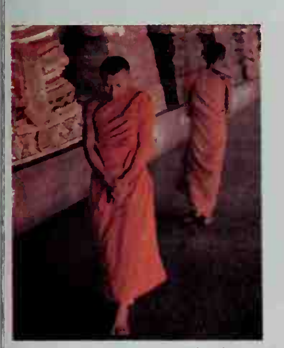
Bruno Barbey, Magnum
Leather clothing in Brazil



© Cary Wolinsky, Stock, Boston
Wool clothing in Australia

Differences in clothing customs result in differences in clothing styles. Such special clothing as uniforms and ceremonial garments clearly illustrate the influence of clothing customs. The pictures below show clothing worn by religious groups and police forces in various countries.

Religious clothing



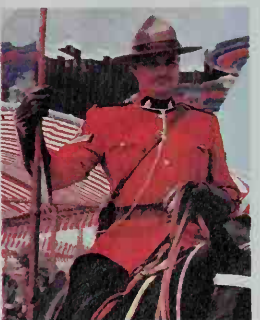


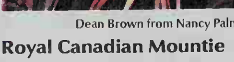
Marc Riboud, Magnum
Buddhist monks in Thailand



C. Knight, Photo Researchers
Catholic nuns in the U.S.

Police uniforms





Dean Brown from Nancy Palmer
Royal Canadian Mountie



Marilyn Silverstone, Magnum
Policeman in India

Traditional costumes

Traditional costumes of many lands are shown on the following four pages. Such styles of clothing developed over hundreds of years. Many of the costumes shown are no longer worn, or are worn only as part of celebrations during festivals and holidays. This is especially true of the European costumes shown. Many of the costumes on the first two pages are still worn as everyday dress, particularly in rural areas. Traditional costumes are often called *national costumes.* But most such costumes do not represent all the people of a nation.

All illustrations in this section created for WORLD BOOK by Bill Randall and Carl Link.

Africa and the Middle East



Morocco



Senegal



Ghana



Kenya



Somalia



Syria

Israel



South Africa



Egypt



Congo (Kinshasa)

Ethiopia



Nigeria



Saudi Arabia

Asia and the Pacific Islands



Europe


Switzerland
Germany
Austria
Norway
Sweden


The Netherlands
Scotland
Wales
France
Greece


Spain
Czech Republic
Russia
Hungary


North and South America
United States Inuit (Eskimos)
Mexico
United States Cowboy
United States Indians
Guatemala
Brazil
Chile
Ecuador
Bolivia
Argentina
Peru

Clothing through the ages

For thousands of years, people have worn some kind of clothing. They probably made their first clothes from the fur of animals they killed. Gradually, they learned to use other materials. They also invented tools and machines to weave cloth and sew clothing.

This section of the article covers chiefly the history of clothing in the Middle East, Europe, and North America. The people of these regions have made the greatest contribution to the development of the Western style of dress. Information about non-Western clothing appears in other *World Book* articles. For example, see the **Indian, American,** article to learn about the clothing of North and South American Indians. See the **Africa** and **Asia** articles for information about clothing worn on those continents. Also see such country articles as **Argentina** and **Japan** to learn about the clothing worn by the peoples of those countries.

Ancient times began more than 5,000 years ago and lasted until about the A.D. 400's. Most of our information about clothing worn in ancient times comes from vases, statues, and *frescoes* (wall paintings). A large amount of jewelry has survived from the period. However, few woven fabrics or leather items have lasted through the years. Some garments from ancient times have been preserved under special conditions, such as the dry climate of Egypt.

The colors of most ancient paintings and statues have worn away through the centuries. For that reason, clothing shown on such items appears white or light-colored. Some ancient peoples—such as the Egyptians—actually wore white clothes. But many other peoples probably wore colorful garments. For example, frescoes uncovered during the 1700's at the site of the ancient Roman city of Pompeii show people wearing brightly colored clothing.

The Egyptians used linen in making most of their clothes. Many slaves and children did not wear clothes, but high-ranking families wore them to indicate their status in society. The Egyptians wore garments made of rectangular pieces of fabric.

During the early years of the ancient Egyptian civilization, men wore a wide girdle, a diaperlike *loincloth,* or a short, wraparound skirt. Through the years, men began wearing longer skirts, and they often wore one skirt over another. Egyptian women at first wore sheathlike dresses. These tight-fitting garments had either one or two straps over the shoulders. Most of the dresses hung to the feet and left the breasts bare. The women often wore jewelry.

Later, both men and women often wore long, robelike garments instead of skirts and dresses. They made these robes by folding rectangular pieces of cloth in



Wooden statue from Egypt (2300's B.C.) The Brooklyn Museum, Brooklyn, N.Y., Charles Edwin Wilbour Fund

Skirts were a common type of clothing worn by many Egyptian men. Men often wore one skirt over another. The Egyptians made most of their clothes from linen.



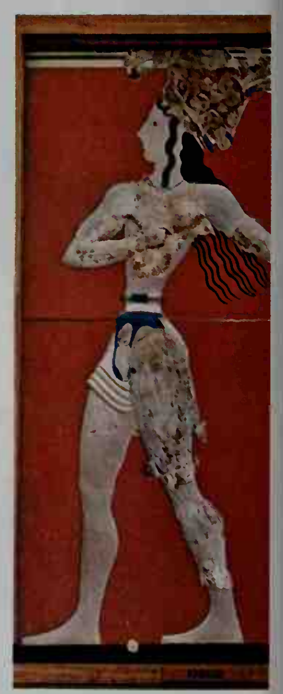
Stone statue from Sumer (about 2800 B.C.); (Raymond V. Schoder, S.J.)

The kaunakes was a type of skirt worn by the Sumerians. Historians believe that the kaunakes was made of sheepskin or of cloth covered with several rows of wool fringe.



Sculpture from Iraq (800's B.C.); The Brooklyn Museum, Gift of Hagop Kevorkian (Robert S. Crandall)

The Assyrians usually put fringe on their clothing. King Ashurnasirpal II, *above,* wore the style of beard and long, curled hair common among Assyrian men.



Wall painting from Knossos, Crete (about 1500 B.C.); (Raymond V. Schoder, S.J.)

The Cretans wore clothing different from that of any other ancient people. The men wore short skirts held up by a belt. Some of these belts may have been metal.

half lengthwise and cutting a hole on the fold for the head. People wore the robes draped in various ways. Sometimes they let the robes hang straight and full. Other times they tied the robes at the waist with a wide sash.

Egyptian men and women both wore wigs made of human hair, palm-leaf fibers, or wool. Many men shaved their heads, and so did some women. Men and women occasionally wore sandals, but most Egyptians went barefoot. See **Egypt, Ancient** (Food, clothing, and shelter; pictures).

The Sumerians, Babylonians, and Assyrians herded sheep and dressed in the wool their flocks provided. They lived in Mesopotamia, an area that extended through parts of what are now Iraq, Syria, and Turkey. The Sumerians lived in the southern part of this region. The Babylonians lived in the center, and the Assyrians in the north.

The Sumerians wore either a smooth-fitting skirt with fringe at the bottom or a skirt called a *kaunakes.* Some historians believe the kaunakes was made of cloth covered with rows of wool fringe. Others think it was made of shaggy sheepskin. Sumerian women wore a capelike garment in addition to the kaunakes. The Assyrians and Babylonians wore chiefly a large shawl or scarf wrapped around the waist and hips. They arranged this garment with one end draped over the left shoulder. The Assyrians and some Babylonians wore a short-sleeved tunic under the shawl.

The people of Mesopotamia usually had fringe on the edges of their clothing. During the early years of this period, they wore various types of headdresses and generally went barefoot. Later in the period, these people wore sandals, shoes, and boots. Assyrian men were noted for their long, heavy, curled hair and their black beards.

The Persians were among the first people to cut and fit garments, rather than simply drape themselves in pieces of fabric. Ancient Persia covered much of what is now Iran.

The Persians were hunters and horsemen. Historians believe they began to wear fitted animal skins because the fitted clothing was better suited to hunting and riding than were loose, flowing garments. Later, they made garments of woven cloth.

Persian men wore trousers that were tightly fitted at the ankles. Shoes or boots were worn with the trousers. The men also wore tunics and coats with sleeves. Persian women wore garments similar to those of the men, but they also wore long veils. Persian garments set a pattern for the fitted type of clothing that later developed in western Europe.

The Hebrews left little information about their clothing. The Old Testament provides some description of early Hebrew garments, and some paintings and carvings from the years of Assyrian and Egyptian rule show Hebrew people. These sources indicate that the Hebrews dressed much like their Middle Eastern neighbors, who wore wraparound shawls and tunics. According to the Bible, the Hebrews sewed tassels on their clothing. The men wore locks of hair called *sidelocks* on the side of the head. For religious reasons, the Hebrews avoided wearing clothing made of a mixture of linen and wool.

The Cretans lived on Crete, an island about 80 miles (130 kilometers) south of Greece. They wore clothes unlike those of any other ancient people. Cretan women wore dresses that had the tight-waisted, corseted look of Western women's dress of the mid-1800's. Skirts on the dresses were long and bell-shaped with layers of wide ruffles. The women's blouses had sleeves but left the breasts bare. The women used hair ornaments, necklaces, and other jewelry.

Cretan men wore short skirts that dipped in front and back. The skirts were held at the waist by tight belts, some of which may have been metal. Men wore boots or sandals or went barefoot. Both men and women wore various types of headdresses.

The Greeks wore soft, flowing garments made of rectangular pieces of cloth. Men and women wore the same types of clothes. Common garments included the *chiton,* a straight, hanging garment fastened at the shoulders and tied at the waist, and the *himation,* a kind of large cloak. The *chlamys* was a shorter cloak for a man that left his fighting arm bare.

Greek jewelry included gold earrings, hair decorations, and brooches called *fibulae* for fastening garments at the shoulder. The people went barefoot at home and wore boots or sandals for hunting and traveling. Men wore a broad-brimmed hat called the *petasos* and a narrow-brimmed or brimless hat called the *pilos.* Greek women decorated their heads with a great variety of bands, caps, and scarves. See **Greece, Ancient** (pictures).



Archaeological Museum, Knossos, Crete (Bernard G. Silberstein from Rapho Guillumette)

Cretan women wore fancy dresses similar to that of the Cretan snake goddess shown above. The women also wore hair ornaments, necklaces, and other kinds of jewelry.



Sculpture from the Acropolis, Athens (about 460 B.C.) (Raymond V. Schoder, S.J.)

The chiton, *above,* was a straight, hanging garment commonly worn by the Greeks. They often used brooches called *fibulae* to fasten the chiton at the shoulder.



Statue, *Sosaodra of Calomis* (about 460 B.C.) (Raymond V. Schoder, S.J.)

Greek men and women both wore soft, flowing garments. The Romans had similar styles of clothing because they based their garments chiefly on those of the Greeks.



Statue (A.D. 100's); The Louvre, Paris

Roman boys wore a good luck charm called a *bulla* around the neck. They wore it until manhood. The boy shown above has on a type of cloak called a *toga*.

The Romans wore clothing based chiefly on that of the Greeks. The Greek chiton and himation became the Roman *tunic* and *pallium* for men and the *stola* and *palla* for women. The tunic varied in length but was short for soldiers. The stola hung to the floor. It was worn over a long tunic called the *tunica talaris,* a short shirtlike garment called the *camisia,* and a tight, corsetlike band of cloth called the *strophium.* The pallium and palla were outdoor garments that the Romans could use as blankets if necessary.

Roman citizens wore a carefully draped cloak called a *toga.* The toga hung over the left shoulder and was wrapped around under the right arm. Only people who were citizens of Rome could wear it. Slaves and exiled citizens were forbidden to wear the toga. Freed slaves were required to have special permission to wear it. See **Toga.**

Later in the Roman period, both men and women wore a type of wide-sleeved tunic called the *dalmatica.* Boys and girls wore a locket called the *bulla* as a good luck charm. Boys wore the bulla until manhood. Girls wore it until they married. Men wore sandals, shoes, and boots. Women usually wore sandals, though they also wore shoes.

The Romans developed an enormous trade in textiles. They imported woolens from Britain and Gaul, linen from Egypt, cottons from India, and silks from China and Persia. See **Rome, Ancient** (pictures).

The Middle Ages began with the fall of the West Roman Empire in the late 400's and lasted until about the 1400's. During the Middle Ages, western Europe developed independently of what remained of the old Roman Empire, which was called the *Byzantine,* or *East Roman, Empire.*

The Byzantine Empire. The ruling classes of the empire wore highly decorated cloaks and tunics. These wealthy people used silk fabrics woven with threads of gold, and they decorated their clothes with pearls and precious stones. Poorer people wore plain tunics and blouses.

During early Byzantine times, the emperor and the men of his court wore a type of cloak called a *paludamentum* over their tunics. The empress also wore a paludamentum, and with it she wore a wide jeweled collar called a *maniakis.* Women of the court wore long stolas and pallas. In later Byzantine times, the emperor and empress wore a long, narrow scarf called a *lorum* instead of a paludamentum. Noblemen began to wear long, tight stockings called *hosa.*

Western Europe. The Celtic peoples of Britain and Gaul had adopted some ideas from Roman clothing during the time of the Roman Empire. During the Middle Ages, the styles of the Byzantine Empire gradually blended with those of western Europe. Through the years, Byzantine clothing increasingly influenced the style of dress in western Europe. Members of the ruling classes especially began to wear clothes that were fancier than the usual rough garments made of cloth, fur, and leather.

During the early Middle Ages, people made their



Detail of a mosaic (524-547); Church of San Vitale, Ravenna, Italy (Raymond V. Schoder, S.J.)

Clothing of early Byzantine times included garments like those worn by the emperor and the men of his court. The picture above shows Emperor Justinian and some of his attendants.

clothes at home as they had done for hundreds of years. Families raised sheep and grew flax. They spun thread and wove it into fabric for their clothes. As towns grew, specialized shops gradually appeared, run by weavers, tailors, cobblers, and other craftworkers who made clothes. During the 1100's, these craftworkers began to organize simple labor unions called *guilds* (see **Guild**). The quality of cloth improved as the craftworkers developed greater skills. They began to cut, fit, and decorate clothes in more elaborate ways.

Men and women of the early Middle Ages wore simple tunics and circular or rectangular cloaks. Later, fitted clothes began to replace the loose, flowing cloaks and tunics. The woman's tunic developed into a long dress that was laced to closely fit the upper part of her body. Men wore loose breeches under their tunics. They also wore various kinds of tight leg coverings. For example, they might wrap their legs in long pieces of cloth or wear long stockings of bright colors.

During the 1100's and 1200's, women wore metal hairnets, veils, and draped throat covers called *wimples*. Men wore hoods that had long tails called *liripipes*. Both men and women wore a type of outer tunic—adopted from the crusaders' garments—called a *surcoat*. Some surcoats were sleeveless and cut with low armholes. The woman's surcoat was long and worn over a long-sleeved gown. Men wore sleeveless surcoats of various lengths from the knee to the ankle.

During the 1300's, clothes of the upper classes became increasingly fancy, and accessories became popular. Dozens of buttons were used to trim men's outer garments. Many clothes had decorative edging called *dagging*. Men wore a close-fitting, low-waisted jacket called a *cote-hardie* with an expensive jeweled belt. A long, tight-fitting gown worn by women had the same name. In the late 1300's, both men and women wore fancy garments called *houppelandes*. At first, the man's houppelande was a long outer garment that hung to the floor. It was gradually shortened and became a jacket. The woman's houppelande was long and high-waisted with long, flaring sleeves.

In the later Middle Ages, the wealthy wore silks and other fine fabrics woven in Italy and Spain or brought to Europe from the East by traders. Lords and ladies of the courts trimmed their clothes with expensive ermine, marten, and sable fur. But most people wore linen and wool clothes. They dressed in much plainer styles than those worn by the ruling classes. The lesser nobility and the middle classes lined and trimmed their clothes with fox, otter, and rabbit fur. The common people wore garments made of the skins of goats, sheep, or wolves. See **Middle Ages** (pictures).



Detail of an illuminated Old Testament manuscript; The Pierpont Morgan Library, New York City

The surcoat was a tunic worn in Europe in the 1200's. These knights wear surcoats over chain-metal armor.



Detail of an illuminated manuscript, *Le Roman de la Rose*; Bibliothèque Nationale, Paris (Hubert Josse)

The wimple was a throat cover worn by western European women during the 1200's. The women wore it with various hoodlike head coverings.



Detail of *Elderly Couple* by Jan Gossaert (about 1520); The National Gallery, London (Raymond V. Schoder, S.J.)

Fur trim was worn on clothing during the 1400's and 1500's. Fox and rabbit fur were often used.



Detail of a painted chest; Accademia di Firenze, Florence, Italy (Hubert Josse)

Italian clothing became more elaborate during the Renaissance than ever before. In this wedding scene, the two men at the far right wear a kind of draped turban called a *chaperon*.

The Renaissance began in Italy about 1300 and spread throughout Europe during the 1400's and 1500's. Towns thrived during the Renaissance, and the number of merchants and craftworkers grew rapidly. The Byzantine Empire fell, and western Europe took the lead in clothing design. European dress of the 1400's shows the influence of ideas and attitudes that developed during the Renaissance.

Clothing was fancier and more complicated than ever before. Women wore many kinds of elaborate headdresses, including the high, cone-shaped *hennin.* The hennin—worn in many European countries during the late 1400's—rose 3 to 4 feet (0.9 to 1.2 meters) high and was draped with a veil. Jewelry and bright-colored fabrics with large, flowered designs were popular.

Men wore longer stockings as jackets became shorter. The stockings became close-fitting trousers that resembled tights. Men wore many kinds of hats, including a draped turban called the *chaperon.* They also wore pointed-toe shoes called *poulaines.* On some shoes, the points measured 6 inches (15 centimeters) or more.

Men of the early 1500's wore many layers of outer garments, and their clothing was heavily padded. They put on linen shirts under tight-fitting upper garments called *doublets.* Over the doublet, they wore a jacket called a *jerkin,* which had a skirt that hung to between the waist and the knee. A knee-length gown with large sleeves came over the jerkin. Men also wore short, puffed breeches called *upper stocks* that were sewn to tight stockings called *netherstocks.*

Women's clothing was cut and sewn to fit tightly above the waist. During the first half of the 1500's, women wore dresses with low, square necklines and with skirts propped out stiffly over petticoats. Many skirts were split in front to show elaborate underskirts. Both men's and women's garments were often slashed so that the fabric of garments worn underneath could be pulled through in small puffs.

The stiff and formal fashions of the Spanish court influenced styles throughout Europe during the late 1500's. Men wore stockings and either padded breeches called *trunkhose* or slimmer knee breeches. Padding in the doublet developed into the *peasecod belly* fashion, which had a pointed bulge over the abdomen. The wide skirts of women's dresses were supported by a device called a *farthingale.* One type of farthingale was an underskirt with a rigid frame made of whalebone, wire, or wood. The frame made the skirt stand out stiffly away from the body. Another kind of farthingale was a long, thick pillow that women tied around the waist under a dress. Both men and women wore fancy starched collars called *ruffs.* See **Renaissance** (pictures).



Lady with a Pink by Hans Memling. The Metropolitan Museum of Art, New York City, the Jules S. Bache Collection, 1949

The hennin was a style of high, cone-shaped headdress worn by European women during the Renaissance.



Detail from a manuscript of the 1400's; Bibliothèque Nationale, Paris

Renaissance clothing included men's hats with the brim pointed in front and turned up in back. King Louis IX of France wore such a hat when he started on a crusade, as shown above.



Detail of *Portrait of Lady Guilford* by Hans Holbein the Younger; The City Museum, St. Louis (Raymond V. Schoder, S.J.)

Puffs of fabric were often pulled through slashes in clothing in the Renaissance.



Earl of Leicester by an unknown artist; National Portrait Gallery, London

Stylish men of the 1500's wore a *peasecod belly,* which bulged over the abdomen.



Portrait of Marchesa Doria by Anton van Dyck; The Louvre, Paris (Raymond V. Schoder, S.J.)

The ruff was a large starched collar worn by men and women in the Renaissance.

The 1600's. Fancy, decorated clothing remained popular throughout most of Europe during the 1600's. Spain declined in importance, and France took the lead in setting clothing styles.

Men began to replace their doublets with waistcoats worn under knee-length coats. In the mid-1600's, loose, knee-length trousers took the place of tight, padded breeches. But knee breeches came back into style by the end of the century.

Except in Spain, women began to wear many petticoats instead of farthingales under their gowns. Women also started wearing three-quarter sleeves. This startling change bared female arms for the first time since the fall of the Roman Empire more than 1,000 years earlier. With the shorter sleeves, women wore muffs and longer gloves. By the late 1600's, they were wearing *bustle* gowns. A bustle was a cushion that made a skirt stick out in back. Women also wore a type of high headdress called a *fontange.*

Men often wore high boots, and they carried a sword on a long sash that hung over the shoulder. They also wore fancy plumed hats over their long hair. Both men and women began to wear heeled shoes, many of which were trimmed with bows and buckles. Flat collars made of lace and linen gradually replaced the stiff ruff. A scarflike neckcloth, in turn, succeeded the flat collar in the late 1600's. Men began wearing huge, curled wigs called *periwigs* by about 1660.

The Puritans in England and the Puritan colonists who came to America preferred plainer versions of the clothing of the day. The women wore plain, dark-colored dresses and simple white caps. The men cut their hair short and wore high, stiff hats. They dressed in dark-colored breeches, doublets, and jerkins. Both men and women wore white collars.

The 1700's brought many changes in the manufacture of cloth. About 1764, James Hargreaves, an English weaver, invented the *spinning jenny,* a machine that spun a number of threads at the same time. Then, between 1774 and 1779, an English weaver named Samuel Crompton developed the *spinning mule.* This machine produced as much thread as could 200 persons spinning by hand. In the mid-1780's, Edmund Cartwright, an English clergyman, developed a steam-powered loom. With such machines as these, English weavers produced large quantities of cloth at prices lower than those charged by guild craftworkers, who wove by hand. Large factories took over the production of cloth, and many people stopped making cloth at home. See **Industrial Revolution.**

Clothing styles changed rapidly. But only the nobility and the wealthy could afford the new fashions. Most people still wore comfortable, long-lasting woolen clothing. Many continued to make their own fabrics and clothes.

French fashions set the clothing standards in Europe during most of the century. But late in the 1700's, the French Revolution interrupted France's fashion leadership, and England took the lead. After the revolution, France regained leadership in the design of women's clothes, but English tailoring continued to influence men's fashions. Clothing styles in England and France

James Stuart, Duke of Richmond and Lennox by Anton Van Dyck, The Metropolitan Museum of Art, N.Y.C., Gift of H. G. Marquand

Clothing of the 1600's included fancy, heeled shoes for men and women. Many shoes were trimmed with bows. Lace and linen collars became popular in the 1620's.



Marie Thérèse of Spain, Queen of France, and the Grand Dauphin by Pierre Mignard; The Prado, Madrid (Hubert Josse)

Three-quarter sleeves were worn by women during the 1600's, as were long gloves or muffs. To make their dresses curve out from the waist, women wore many petticoats.



Detail of *Salon of Madame Geoffrin* by an unknown French artist; National Museum of Versailles and of the Trianons, Versailles, France (Hubert Josse)

Waistcoats worn under knee-length coats replaced the doublet as the fashion for men during the 1600's. Men wore knee breeches during much of the century.



Detail of *Portrait of the Artist with his Wife and Daughter* by Nicolas de Largillière; The Louvre, Paris (Bulloz)

Periwigs were huge, curled wigs worn by men during the late 1600's and the 1700's. Men began to wear a scarflike neckcloth instead of the flat collar in the late 1600's.

affected those in the United States. Many Parisian designers distributed dolls dressed in fashions to be copied in England, America, and other parts of the world.

Both men and women wore fancy hairstyles. Men covered their heads with large powdered wigs of various shapes. By the 1770's, women wore their hair in high, carefully arranged styles called *pompadours.* They made their hair stiff with grease and powder and decorated it with feathers, jewels, and ribbons. They also added hairpieces to their own hair and wore wigs. Sometimes women did not comb out or re-dress their hair for several weeks because the styles were so complicated.

Women wore tight corsets and great round skirts held out by a hoop. During the 1780's, a bustle replaced the hoop. The style included very large fancy hats. Men wore variations of the coats, waistcoats, and breeches introduced during the late 1600's.

The outbreak of the French Revolution in 1789 brought great changes in clothing style in France and throughout the rest of Europe as well. Men started to wear much plainer clothes, with less color and ornamentation. They adopted top hats and hats called *bicornes.* Bicornes had brims folded up to form two points. These hats replaced the *tricorne.* The tricorne, which had the brim folded to make three points, had been popular for most of the 1700's. Women began wearing clothing that imitated the styles of ancient Greece. This clothing included sandals and lightweight cotton dresses. Women cut their hair short and curled it, and they wore wide-brimmed bonnets. Dresses had low necklines and high waistlines with drawstrings. This dress style became known first as *Directoire* and then, in the early 1800's, as *Empire.*

The 1800's. Much production of clothing by hand ended during the 1800's, and the clothing industry became firmly established in the United States. Two Americans—the inventor Elias Howe and a machinist named Isaac Singer—developed improved sewing machines in the mid-1800's. These machines and other inventions made the manufacture of cloth and clothing easier. Manufacturers began to make inexpensive, ready-to-wear clothes. Production methods used by manufacturers gradually improved. But many people still preferred to have their clothes made by a tailor or dressmaker if they could afford it. Others continued to wear homemade garments.

The Empire style lasted until the 1820's. Tight-waisted, full-skirted gowns became popular during the 1830's and 1840's, and women wore many petticoats under them. By the 1850's, women wore stiff wire or whalebone petticoats called *crinolines* to support their skirts. Earlier types of crinolines were underskirts made partly of horsehair.

By the 1870's, full-skirted dresses gave way to bustle gowns. In the 1880's, a European designer introduced the first suits for women. A type of blouse called a *shirtwaist*—worn with a separate skirt—became fashionable in the Gay Nineties. Women wore costumes that were designed in an "hourglass" style. This style required a woman to lace in her waist tightly to make it as small as possible.

In the 1800's, men's clothes continued to become plainer. By about 1815, fashionable men in Europe and the United States were wearing trousers instead of knee breeches, whjch had been the style for more than 200 years. For general wear in the early part of the century, men wore the long *tail coat.* Later, the knee-length, full-skirted *frock coat* replaced the tail coat. Then the plain *sack coat,* which is still worn today, replaced the frock coat. Men kept the tail coat for formal wear only. A coat called the *tuxedo* was also worn for formal occasions in the late 1800's. Men also wore caps, round bowler hats, high top hats, and straw hats. *Knickers,* which resem-



Detail of *Gathering in a Park* by Louis Joseph Watteau; Cognacq-Jay Museum, Paris (Bulloz)

Large, fancy hats became stylish for women during the late 1700's. Women also wore tight corsets and round skirts.



Detail of *Portrait of Madame Seriziat* by Jacques Louis David; The Louvre, Paris (Hubert Josse)

Women's clothing became simpler in the early 1790's. Fashionable women wore lightweight cotton dresses.



Engraving; Library of the Carnavalet Museum, Paris (Lauros-Giraudon)

Tight-waisted dresses with full skirts were popular in the 1830's. Women wore many petticoats under their skirts.



Engraving; Carnavalet Museum, Paris (Lauros-Giraudon)

Fashionable men of the 1800's wore the frock coat, *left,* the tail coat, *center and right,* and top hats.

bled the old knee breeches, became popular for sports after 1870.

The 1900's. From 1890 to 1920, improved manufacturing methods brought rapid growth to United States companies that made ready-to-wear clothing. Both men and women began to wear mostly clothing that was *mass-produced* in factories (see **Mass production**). As a result of mass production, women's fashions could change more rapidly than ever before. But men's clothing styles changed little until the 1960's.

In the 1900's, styles of women's clothing changed quickly. In general, women began to wear looser, lighter-weight clothing. However, for a few years around 1910, women wore *hobble skirts.* These skirts were so tight at the bottom that a woman could hardly walk. Clothing became simpler and less formal during World War I (1914-1918). In the 1920's, women adopted the "boyish" look. Dresses were straight and unfitted, and they ended at, or a little above, the knee. In the 1930's, some women began wearing slacks. Skirts became longer during the 1930's and then shorter during the early 1940's. During World War II (1939-1945), women wore many tailored styles with padded shoulders. Many women working in war industries wore slacks, which soon went on to become a popular item of clothing among other women.

Women's fashions changed greatly after World War II. Crinolines and long, full skirts returned. Nylon garments, including stockings and *lingerie* (underwear), became available in large quantities. During the 1950's, straight, tight-fitting *sheath dresses* and shorter hemlines gained popularity. Loose-fitting dresses called *shifts* and *A-line dresses,* which were narrow at the top and wide at the bottom, came into style during the early 1960's. The very short *miniskirt* quickly spread to other countries after it first appeared in the United Kingdom during the mid-1960's.

From 1900 to 1950, both single-breasted and double-breasted men's suits were popular. Shoulders were *natural* (unpadded) about 1910 but gradually became more padded. During the 1950's, many men switched to single-breasted *Ivy League* suits, which had narrow lapels and natural shoulders. They also began wearing colored shirts with business suits.

Both men and women developed great fondness for sportswear and wash-and-wear fabrics during the 1950's and 1960's. Leisure and sports clothes for women included knee-length Bermuda shorts, tapered slacks, and ski and stretch pants. Men wore Bermuda shorts, slacks, and colorful sport shirts. Improvements in sewing machines and in dress patterns brought an increased interest in sewing.

In the late 1960's, many young men started to wear colorful fashions, many of which included fancy jewelry. During the early 1970's, men of all ages joined in the change to colorful clothes. They began wearing shirts in checks, stripes, and many colors with business suits. Wide neckties in fancy prints, stripes, and bright swirling colors also came into style. Women's fashions included skirts of every length—from the miniskirt to the *maxiskirt,* which fell to the ankle. Many people seemed to have an "anything goes" attitude toward clothing styles.

During the 1980's, men's and women's fashions "softened." In the early 1980's, men wore suits with padded shoulders but a loose fit. By the late 1980's, suits had natural shoulders and were less formal. Women's fashions included many options. Women wore slacks, skirts of every length, and sportswear that combined sweaters, jackets, skirts, and dresses. Exercise wear that fit tightly was popular, but so too was oversized, baggy clothing. In the 1990's, professional wear became more casual. Many businesses no longer required employees to wear suits or even jackets.



Bettmann Archive

The hourglass style was worn by women during the 1890's. This style called for waists laced in tightly to make them as small as possible.



Photo Researchers

The boyish look was fashionable during the 1920's. Women wore straight, unfitted dresses that hung to the knee, and long necklaces.



Photoworld

Pants outfits became stylish for women during the 1940's. Fashionable women generally wore tailored styles with padded shoulders.



M. A. Keller, The Stock Market

Tailored clothing with loose, casual styling became popular business wear for both men and women during the 1980's and early 1990's.

The clothing industry

The clothing industry is one of the largest industries in the world. It includes the manufacture of women's, children's, and infants' clothes and men's and boys' wear. It also produces furs, including "fake furs"; embroidery; hats, jewelry, shoes, and other accessories; items called *findings* (buttons, hooks, snaps, zippers, and thread); underwear and sleepwear; foundation garments; and sportswear.

The main clothing centers of the world are London, New York City, Paris, and Milan. The United States is one of the world's largest producers of clothing. The largest number of garment factories in the United States operate in the Middle Atlantic States—New York, New Jersey, and Pennsylvania. However, California has more clothing manufacturers than any other state. The leading clothing manufacturing centers of the United States include Dallas-Fort Worth, Detroit, Jersey City, Los Angeles-Long Beach, New York City, and Philadelphia.

Most clothing manufacturers have small factories. These firms have an average of fewer than 100 employees, though some have as many as 1,000 workers.

Clothing materials include many natural and artificially created substances. People have used some materials, such as animal furs, for clothes for thousands of years. Other materials, including plastic sheetings and artificially created fibers, came into practical use during the 1900's.

Natural materials include fur, leather, and cloth that is made of plant or animal fibers.

Fur and leather provide many of the warmest and longest-wearing clothes. These materials are also used in some of the most expensive, fragile, and luxurious garments. Fur comes only from warm-blooded animals. Leather comes from either warm-blooded or cold-blooded animals.

Fur is used mostly for coats and coat linings. Such furs as *mouton,* a fur made of sheepskin, make warm coats that wear well. Chinchilla fur is soft, fragile, and not so warm as other furs. Most furs are dyed, plucked, sheared, or treated in some other way before being made into clothes. See **Fur**.

Most leather is used to make shoes. Such items as boots, gloves, and handbags—and some hats, jackets, pants, skirts, and suits—are also made of leather. Tanners manufacture leather by treating hides to make them soft and flexible and to prevent them from rotting. Most leather for clothing is made from cowhide. See **Leather**.

Cotton, flax, silk, and wool are the natural fibers most widely used in clothing. They are long and flexible and can easily be made into thread. Cloth made from each of these fibers has a special quality that makes it popular. Silk has great luster and softness, for example, and wool provides warmth.

Threads of cotton, flax, silk, and wool fibers are usually knitted or woven into fabric (see **Knitting; Weaving**). Such methods as braiding and lace making are occasionally used to make clothing materials. Wool can be made into felt by pressing and rubbing together warm, damp wool fibers. Other kinds of fibers do not stick together when pressed unless they have been treated with an adhesive substance.

Cotton fibers come from the *boll* (seed pod) of the cotton plant. Fibers from the stem of the flax plant are woven into linen. Silk, the strongest of all the natural fibers, comes from cocoons spun by silkworms. Sheep provide a majority of the wool that people use. However, such animals as the alpaca, the camel, and various breeds of goats also furnish wool. See **Cotton; Linen; Silk; Wool**.

Manufactured materials include paper, plastic sheetings, rubber, and artificially produced fibers. Clothing manufacturers use a large amount of these materials because they have certain advantages over natural ones. For example, many are stronger, more shrink-resistant, or less expensive than natural fibers.

In 1884, a French chemist and inventor named Hilaire Chardonnet patented the first successful artificial fiber. He called it *artificial silk*. Chardonnet's fiber was first manufactured in the United States in 1910. It was named *rayon* in 1924. Since then, scientists have developed many other artificial fibers, sometimes called *synthetics*. Chemists develop them from natural substances or by combining two or more chemical compounds. The main types of synthetics include acrylic, nylon, olefin and polyester.

Today, many widely used fabrics are blends of natural and synthetic fibers. For example, such fabrics could be a mixture of cotton and polyester or wool and nylon. These fabrics retain certain characteristics of each fiber used in the blend. For example, a fabric made of wool and nylon is warm because of the wool and is shrink-resistant because of the nylon. See **Synthetics** and its list of *Related articles*.

Paper, plastic sheetings, and rubber have been used less in clothes than have synthetic fibers. However, the use of such materials is increasing. Some paperlike fabrics are made of fibers held together by adhesive substances. Others are made by combining synthetic fibers with natural fibers or rayon. The synthetics melt when heated and hold the network of fibers together as a fabric. Fabrics of this type are widely used in making disposable diapers, which are thrown away after being soiled once. Paperlike fabrics are also used for other disposable garments, including bibs, underwear, and rainwear.

Manufacturers use plastic sheetings in making such products as handbags, raincoats, and shoes. Rubber is used chiefly to make such flexible, long-lasting, waterproof clothing as boots and gloves.

Ready-to-wear clothes. Most clothes worn today are mass-produced, ready-to-wear garments. Mass production of clothing saves customers both the time it would take to make clothes themselves and the money they would spend on clothes individually made by a dressmaker or tailor.

Designing is the first step in the manufacture of ready-to-wear clothing. Fashion designers in London, New York City, Paris, and Milan create most clothing styles. They work under great pressure to produce designs—especially of women's fashions—that people will want to buy.

In the United States, most large clothing manufacturers employ their own designers. These experts create

styles in addition to those that come from Paris and the other fashion centers. Manufacturers try to sell the designs to buyers from clothing stores. Most smaller clothing manufacturers purchase designs from independent designers, as do firms that produce garments which change little in fashion.

After a designer has an idea for a style, he or she chooses the colors and types of fabrics in which to make the garment. The designer then makes samples of the garments, and buyers from stores come to see them. If the buyers see a style they think their customers will like and will buy, they order garments of that design. The final test for any style comes when the clothes appear in stores. If enough people buy a particular style, stores will reorder it from the manufacturer. If customers ignore a style, it soon disappears—and another style takes its place.

Manufacturing and selling. After receiving orders from stores for a certain design, the manufacturer cuts patterns of the garment in various sizes. Ready-to-wear clothes come in standard sizes for different ages and figure types.

Clothing manufacturers buy fabrics in large rolls called *bolts.* Expert examiners unroll the bolts of material and inspect them for rips or other flaws. *Spreaders* pile the bolts on large tables. Workers called *markers* outline each pattern in chalk on the material. In some companies, the markers transfer pattern markings to a large piece of paper that serves as a guide for cutting the material. Next, *cutters* use electric cutting machines or hand cutting tools to cut out the various parts of the garments. Then *sorters,* who also are called *assorters, assemblers,* or *bundlers,* number the pieces of material and put all the pieces that are alike in a bundle. The bundles, along with the necessary buttons and trimmings, are then sent to the sewing room.

Most sewers handle only one or two parts of a garment. For example, a sewer may stitch only shoulder seams and hems. Another sewer may make pockets and collars. On some elaborate, expensive coats, dresses, or suits, one person may do all or most of the sewing by hand. *Finishers* do all the outside stitching, such as making buttonholes. *Pressers* iron the completed garments.



WORLD BOOK photo by Ralph Brunke

Ready-to-wear clothes come in a wide variety of styles, colors, and fabrics. Most clothes bought today are of this type.

Some clothing companies handle all the steps in the manufacture and distribution of their products. Others send their cut garments to clothing *contractors,* who sew them together and return them. Sometimes clothing *jobbers* buy cut garments and complete the manufacturing and distribution process. Manufacturers sell most garments directly to retail stores. They may also sell to wholesale dealers, who in turn sell to retailers.

Protecting the public. In the United States, federal laws protect the public in the purchase of clothing. Several of these laws require clothing manufacturers, wholesalers, and retailers to cooperate with textile manufacturers in placing accurate labels on all garments. All garments sold in the United States are required to display the country of manufacture.

The Wool Products Labeling Act of 1939 requires labels on wool fabrics to tell the kind and amount of wool used. If wool fiber from a garment that has been worn is shredded and made into yarn or fabric, manufacturers must label the new product *reused.* If the wool has been made into a fabric before but not used in a garment that was worn, manufacturers must say the wool has been *reprocessed.* The Textile Fiber Products Identification Act of 1958 calls for labels that show fiber content by percentage. This law applies to all fabrics not made of wool. The Fur Products Labeling Act of 1952 requires labeling of fur garments and accessories to identify the type of animal fur and tell if it has been bleached or dyed. The label must also indicate if the garment is second-hand. The Flammable Fabrics Act of 1953 prohibits the sale of fabrics that burn easily.

Leading clothing-producing states and provinces

Value added by manufacture

State/Province	Value
California	$6,923,400,000
New York	$4,631,500,000
Texas	$2,518,700,000
North Carolina	$2,474,700,000
Pennsylvania	$1,793,200,000
Tennessee	$1,667,500,000
Georgia	$1,663,300,000
Michigan	$1,641,000,000
Quebec	$1,507,600,000
New Jersey	$1,348,000,000

Figures are for 1996. All figures are in U.S. dollars.
Sources: U.S. Census Bureau; Statistics Canada.

Fashion designers hold important positions in the clothing industry. The sale of a garment depends largely on the popularity of its design. In turn, the jobs of many people and the profits of many companies depend on the work of designers. People who wish to become fashion designers may take fashion-designing courses in college or attend special design schools in New York City or some other large city.

A successful fashion designer may have special personal qualifications or talents. In addition, most designers know how to drape and sketch new styles, draw and cut patterns, and sew garments. Many designers start their careers as assistants in design departments, as sample makers, or as artists in pattern houses. In time, some designers establish their own firms or form partnerships with other designers.

Fashion coordinators perform a variety of jobs. For example, they may plan an entire fashion show or select the shoes that a model wears for an advertisement. Most large department stores employ fashion coordinators who select merchandise, plan displays, and promote sales. For such work, a person must have a thorough knowledge of current fashion trends.

Fashion writers and artists specialize in describing or illustrating clothes for advertisements and articles in magazines and newspapers and for direct-mail ads. They may work for advertising agencies, department stores, manufacturers, publications, or wholesalers. Experts called *copywriters* prepare the written material for clothing advertisements. They must have a talent for writing and a knowledge of clothing design and materials. Fashion editors decide what current fashions will appear in their publications. They may travel to Paris or other fashion centers to attend fashion shows. These editors must know what types of displays will catch a reader's attention, and they should be able to forecast fashion trends.

Fashion illustrators need some knowledge of clothing construction in addition to a talent for drawing. Fashion photographers must know how to work with fashion models and arrange merchandise attractively as well as how to use camera equipment.

Garment manufacturing. Men and women who are interested in making clothes may become cutters, dressmakers, finishers, sewing-machine operators, or tailors. They must be able to work quickly and skillfully with their hands. Most garment makers start in training positions under experienced workers. People with training in business management or industrial engineering may find opportunities in garment-manufacturing plants as production managers or plant engineers.

Merchandising. Qualified people may find positions with stores as buyers, department heads, or salespeople. In time, they could become officers in a store or chain of stores. Many men and women open their own small retail clothing shops.

A number of colleges and business schools offer specialized management courses that provide training for merchandising positions. Most large department stores and specialty stores offer management-training programs to college graduates and occasionally to experienced members of their staffs.

Teaching. Men and women with enough college training may qualify to teach high school or college courses related to clothing. Teaching specialties include clothing design, the history of clothing, the merchandising of clothes, and the meaning and importance of clothing in society. Richard Martin

Lectra

Fashion designers use CAD (computer-aided design) programs to create original fabric, clothing, and accessory designs. Computer models enable a designer to fit a garment or accessory to any size. The computer's printer can then print out the patterns needed to produce the item.

Study aids

Related articles in *World Book.* See the section of the many country articles in which clothing is discussed, such as Japan (Way of life). See also the following articles:

Articles of clothing

Glove
Handkerchief
Hat
Helmet
Jeans
Moccasin
Necktie
Shoe
Stockings
Turban

Biographies

Armani, Giorgio
Brummell, George Bryan
Chanel, Coco
Dior, Christian
Karan, Donna
Klein, Calvin
Lagerfeld, Karl
Lauren, Ralph
Matzeliger, Jan Ernst
Saint Laurent, Yves
Stetson, John Batterson
Strauss, Levi

Clothes making and care

Dry cleaning
Dye
Fashion
Knitting
Sewing
Spinning
Textile
Union of Needletrades, Industrial and Textile Employees
Weaving

Clothing materials

Acetate
Acrylic
Aramid
Broadcloth
Brocade
Calico
Camel's-hair cloth
Canvas
Cashmere
Chenille
Corduroy
Cotton
Damask
Denim
Felt
Flannel
Fur
Gabardine
Gingham
Jersey
Lace
Leather
Linen
Mohair
Muslin
Net
Nylon
Percale
Polyester
Ramie
Rayon
Satin
Silk
Spandex
Swiss
Synthetics
Tweed
Velcro
Velvet
Voile
Wool

Clothing in history

Colonial life in America (Clothing; pictures)
Egypt, Ancient (Food, clothing, and shelter; pictures)
Gauntlet
Greece, Ancient (Food, clothing, and shelter; pictures)
Indian, American (Clothing; pictures)
Knights and knighthood (Clothing)
Pioneer life in America (Clothing)
Renaissance (pictures)
Roaring Twenties (Changing attitudes; pictures)
Rome, Ancient (Food, clothing, and shelter; pictures)
Toga
Tunic
Western frontier life in America (Clothing)

Other related articles

Batik
Button
Doll (Costume dolls)
Easter (Wearing new clothes)
Embroidery
Fiber
Fire department (Protective clothing)
Hairdressing
Jewelry
Modeling
Needle
New York (Manufacturing)
Pin
Sewing machine
Tartan
Thread
Twill
Washing machine
Zipper

Outline

I. Why people wear clothes
- A. Protection
- B. Communication
- C. Decoration

II. Clothing around the world
- A. Why clothing varies
- B. Traditional costumes

III. Clothing through the ages

IV. The clothing industry
- A. Clothing materials
- B. Ready-to-wear clothes
- C. Protecting the public

V. Career opportunities

Questions

What are the three main reasons for wearing clothes?
What improvements did the *spinning jenny* and the *spinning mule* bring to the manufacture of cloth?
What are some ways in which federal laws protect the U.S. public in the purchase of clothing?
What advantages do synthetic fibers have over natural ones?
When did people learn to make yarn and cloth?
How do customs influence clothing styles?
What cities rank as the world's chief clothing centers?
Who were among the first peoples to wear fitted clothes?
Why does clothing vary in different parts of the world?

Additional resources

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Clotho. See Fates.

Cloture, also called *closure,* shuts off debate in a legislative body. A legislature may vote to effect cloture. Free and open debate is necessary in a democracy in order to reach sound decisions and protect minority groups. But if debate is unlimited, a minority in a legislature may prevent any action simply by continuing to debate. This activity is known as *filibustering.*

In 1917, the United States Senate adopted a rule that provided for cloture upon the vote of two-thirds of the senators present. The Senate amended the rule in 1975 to require a vote of at least 60 senators, three-fifths of its members, to achieve cloture on most issues. On proposed changes in Senate rules, however, cloture requires a vote of two-thirds of the senators who are present. Peter Woll

See also **Filibustering.**



Peter Black, Tom Stack and Associates

A towering cumulus cloud may rise to great heights and may develop into a cumulonimbus cloud that brings a thunderstorm.



Van Bucher, Photo Researchers

High cirrus clouds look like tufts of hair. They are so high and cold that the water they contain is frozen into ice crystals.



Van Bucher, Photo Researchers

Medium-high altocumulus clouds, *shown here,* may appear as small cloud patches arranged in bands or irregular groups.



Bernie Mendoza, Tom Stack and Associates

Some cumulonimbus clouds, known as *mammatus* clouds, have rounded bumps on portions of their undersides.

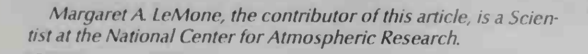


Russ Kinne, Photo Researchers

Low stratus clouds cover the sky with a thick, even blanket. These clouds usually bring rain or snow.

Cloud is a mass of water droplets or ice crystals so small that the tiniest puff of wind can prevent them from falling. Fluffy clouds moving across a blue sky, or the colors of clouds at sunset, are part of the beauty of nature. Clouds also play an important part in the earth's weather. The water that they bring as rain or snow is necessary to all forms of life. Clouds can also bring destruction or even death, in the form of hail or tornadoes.

Some clouds are great fleecy masses, and others look like giant feathers. Still others are gray or black sheets that darken the sky. Most clouds change shape continuously, as new droplets form in some parts of the cloud and droplets evaporate in others. Clouds also change because of the action of winds and other moving air.



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Kinds of clouds

Scientists give names to clouds that describe their appearance. For example, the prefix *strato-* means *layerlike* or *sheetlike*. Clouds that appear as layers or sheets are called *stratus* clouds. The prefix *cumulo-* means *pile* or *heap*, and *cumulus* clouds are piled-up masses of white clouds. The prefix *cirro-* means *curl*, and *cirrus* clouds are curly white clouds. These terms and a few others are used to form the names of the most common clouds. The various types of clouds are grouped into different classes according to their height above the ground.



Josef Muench

Cirrus fibratus and cirrus floccus clouds are thicker than the wispy cirrus clouds, and cover larger areas of the sky.



Ray Brod

Altocumulus undulatus clouds form bands across the sky. The gaps between the bands may be wide or narrow.



Russ Kinne, Photo Researchers

Stratocumulus clouds cover the sky with large, rounded masses within a few thousand feet of the ground.

Feet* Meters*
18
55
Cirrus
50
15
45
40
12
Cirrocumulus
35
30
9
Cirrostratus
Cumulonimbus
25
20
6
15
Altocumulus
10
3
Cumulus Congestus
5
Stratocumulus
Stratus
Stratus
0 0

*Scale indicates altitude in thousands of feet or thousands of meters.

WORLD BOOK diagram by Herb Herrick

Different clouds are seen at various altitudes above the earth. This diagram shows examples of some common clouds and their approximate altitudes. Many clouds are found only within a certain range of altitudes. Other clouds, such as the cumulonimbus, extend from very low to very high altitudes.

Low clouds. Two kinds of clouds, *stratus* and *stratocumulus,* are usually seen near the earth. The bases of most of these clouds are less than 6,000 feet (1,800 meters) above the earth. A stratus cloud looks like a smooth, even sheet. Drizzle often falls from it. A stratocumulus cloud is not as even in thickness as a stratus cloud. It has light and dark areas on the bottom, indicating, as its name suggests, that there are piles of clouds in the layer.

Middle clouds, called *altostratus, altocumulus,* and *nimbostratus,* usually appear from 6,000 to 20,000 feet (1,800 to 6,100 meters) above the earth. Nimbostratus clouds sometimes may be closer to the ground. An altostratus cloud forms a smooth white or gray sheet across the sky. If the cloud is not too thick, the sun may be seen through it. Altocumulus clouds appear in many shapes. They might form bands or unconnected piles. A nimbostratus cloud is a smooth layer of gray. Frequently, the cloud itself cannot be seen because of the rain or snow that is falling from it.

High clouds, called *cirrus, cirrostratus,* and *cirrocumulus,* are formed entirely of ice crystals. Other clouds are mainly water droplets. Cirrus clouds are the delicate wispy clouds that appear high in the sky, sometimes higher than 35,000 feet (10,700 meters). A cirrostratus cloud is a thin sheet of cloud. It often causes a halo to appear around the sun or moon. This halo is a good way to recognize a cirrostratus cloud. Cirrocumulus clouds look like small bands or many small tufts of cotton hanging high in the sky. These clouds are rare.

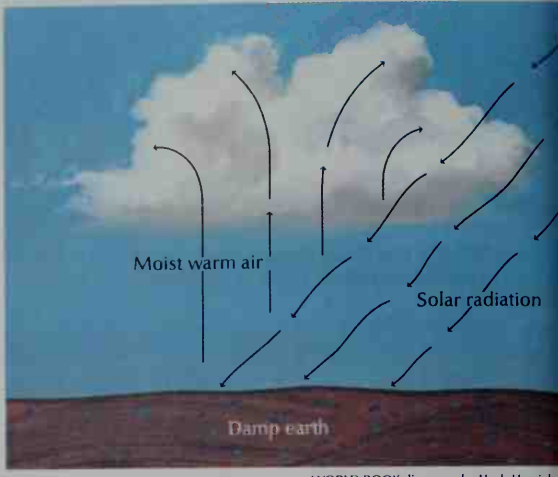
How clouds form

Clouds form when moist air rises and becomes cooler. The air usually rises by (1) convection, (2) lifting, or (3) frontal lifting. Cool air cannot hold as much *water vapor* (the gaseous form of water) as warm air can. Excess vapor changes into tiny drops of water or crystals of ice. These drops or crystals form clouds.



Ray Atkeson

By convection. Solar radiation heats the ground. The ground, in turn, heats the air. The warm air is lighter, and so it rises as a *convection current.* As the air rises, it cools. If the air is moist, some water vapor *condenses* (changes from a gas to a liquid) and forms clouds, such as the cumulus clouds shown here.



WORLD BOOK diagrams by Herb Herrick



© Carlye Calvin

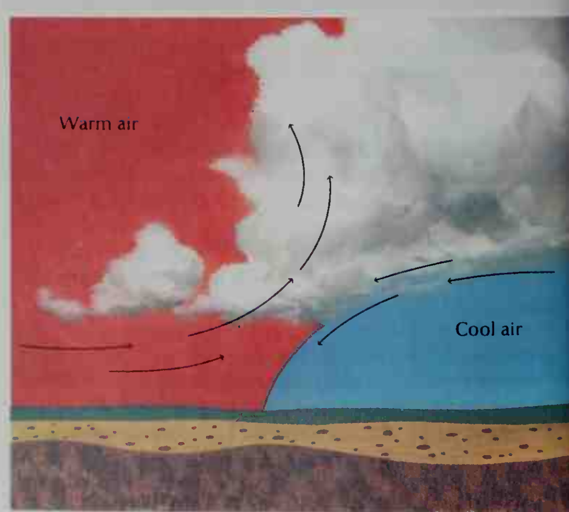
By lifting. Warm, moist air that blows over mountains rises because of the increase in altitude of the terrain. As the blowing air rises, it cools. Some of the water vapor in the air therefore condenses. As a result, clouds form over the mountains. Clouds that have been created in this manner hang over the tops of some mountains permanently.





Robert H. Glaze, Artstreet

By frontal lifting. A weather front occurs where two masses of air that have different temperatures or humidities come together. Along a cold front, a mass of cool air moves under a mass of warm air. As the warm air rises above the cool air, the temperature of the warm air decreases. Water vapor in the warm air therefore condenses, creating many clouds along the front.



Clouds that grow vertically. *Cumulus* and *cumulonimbus* clouds may grow to great heights while their bases are near the ground. Cumulus clouds are heaped-up piles of clouds. They can look like small cotton balls, or they can grow into the most spectacular of all clouds, the cumulonimbus.

A cumulonimbus cloud may reach heights as great as 60,000 feet (18,000 meters) from its base. Its top, which contains ice crystals, spreads out in the shape of an anvil. This kind of cloud is often called a *thunderhead* because it frequently produces thunder. Cumulonimbus clouds also produce heavy rain and lightning. Sometimes hail or, on rare occasions, a deadly tornado comes from a cumulonimbus cloud.

How clouds form

Clouds form from water that has evaporated from lakes, oceans, and rivers, or from moist soil and plants. The evaporated water, called *water vapor,* mixes with the air. Air can hold only a certain amount of water vapor at a given temperature. Warm air can hold more water vapor than cool air. When the air temperature drops to a level known as the *dew point,* the water vapor begins to *condense* (change into liquid), forming tiny water droplets. The level of the dew point depends upon the amount of water vapor in the air—the more vapor, the higher the dew point.

For water vapor to condense in clouds, particles so small they can be seen only through a microscope must be present. These particles, called *cloud condensation nuclei,* become the centers of the droplets. Many of the nuclei form from chemical reactions involving sulfuric acid and ammonia. These nuclei include particles of ammonium sulfate and magnesium sulfate. Other condensation nuclei include tiny particles of dust and particles from smoke. Scientists are not sure whether particles of salt from ocean spray can also act as condensation nuclei. Most droplets measure from $\frac{1}{2,500}$ to $\frac{1}{250}$ inch (0.01 to 0.1 millimeter) across.

If the temperature is below 32 °F (0 °C), and other conditions are right, water vapor does not condense and form a liquid droplet. Instead, the water vapor turns directly to ice through a process called *sublimation.* The ice forms as a six-sided crystal—a miniature snow crystal. For sublimation to occur at temperatures above about −40 °F (−40 °C), a *freezing nucleus* must be present. A freezing nucleus is a small particle that is similar to a cloud condensation nucleus. Most freezing nuclei are dust or tiny specks of plant debris raised by the wind. Freezing nuclei are sometimes called *ice nuclei.*

A cloud often contains both water droplets and snow crystals if the temperature is between 32 and −40 °F (0 and −40 °C). Water droplets do not always freeze at the normal freezing temperature of water, 32 °F. They can remain liquid down to a temperature of −40 °F.

Drops and snow crystals fall when they grow too heavy to be held up by the air. Droplets grow into raindrops through the condensation of additional water vapor onto their surfaces and by combining with smaller droplets. A snow crystal can become heavy enough to fall by growing as water vapor sublimates onto it. In some cases, this water vapor comes from evaporating cloud droplets. Cloud droplets can also freeze onto a snow crystal. In addition, snow crystals can collide with, and stick to, other snow crystals to form snowflakes that are heavy enough to fall. If the snow crystal or snowflake falls through warm enough air, it melts and falls to the ground as rain.

Clouds commonly form in rising air. As air rises, it expands and cools. The expanding air loses heat because it uses energy to push other air aside—and heat is a form of energy. If the expanding air contains so much water vapor that it can cool this vapor to the dew point, clouds will form.

The air can rise in several ways. When the sun heats the ground, the air next to the ground is warmed. Because warmer air is lighter than cooler air, the warm air rises. The upward flow of the warm air is called a *convection current,* and a cloud formed by this process is called a *convective cloud.*

Clouds also form by *lifting.* When warm, moist air moves up the side of a hill or over a mountain range, it is lifted, and it cools by expansion. This cooling causes the water vapor to condense, forming clouds that hang over the mountains.

Frontal lifting, the lifting of air at weather fronts, also produces clouds. At a front, a region where cold air and warm air meet, the warm air rises above the cold air. As the rising air cools, its water vapor condenses and clouds are formed.

Clouds and the weather

Storms. Certain types of clouds often appear before storms. The clouds arrive in a definite order over several days. By watching the clouds, one can often predict the storm. The clouds appear as follows to an observer in the middle latitudes—from about 30° to 60° north latitude and from about 30° to 60° south latitude: First, a few wispy cirrus clouds appear in the west. These gradually thicken and merge, forming cirrostratus clouds that cover the sky. The cirrostratus clouds are later hidden or replaced by a lower layer of altostratus clouds that becomes thicker and hides the sun. Light rain or snow may begin to fall from the altostratus layer. The base of the clouds becomes still lower as nimbostratus clouds move in with heavier rain or snow.

Cumulonimbus clouds may also develop, especially in spring and summer. As a result, the rain may include heavy showers.

As the storm moves past, the rain or snow ends but the sky remains overcast with stratocumulus clouds. Fair weather returns when these low clouds disappear.

Heating and cooling of the earth are influenced by clouds. Most cloudy days are cooler than clear days because the clouds reflect much sunlight back into space. At night, clouds have an opposite influence on the temperature of the air near the surface of the earth. The earth cools by giving off heat toward space. Clouds intercept much of this heat and send it back toward the ground. For this reason, most cloudy nights are warmer than clear nights. Margaret A. LeMone

Related articles in *World Book* include:

Air (Moisture in the air)
Cloudburst
Contrail
Fog
Hurricane
Lightning
Rain
Rainmaking
Tornado
Water (picture: The water cycle)

Cloud seeding. See Rainmaking.

Cloudburst is a sudden heavy rain falling for a short period in a small area. Cloudbursts are usually associated with thunderstorms. They occur most often in desert and mountain regions, and in the interiors of continents, such as the Great Plains of the United States. The uprushing air currents of a thunderstorm support a large amount of water in the form of raindrops. If the air currents are suddenly cut off, the mass of rain quickly falls out over a small area. Stream beds become torrents, and rivers form in valleys that are usually dry. During a cloudburst, more than 1 inch (2.5 centimeters) of rain may fall in 15 minutes. Margaret A. LeMone

See also Cloud; Rain; Weather.

Clove is the name given to the dried flower buds of a tropical tree. The dried buds are used as spices. The name comes from the French word for *nail* because of the shape of the flower bud. The clove tree grows wild in parts of Indonesia and the West Indies. It is grown as a crop in Indonesia, Madagascar, and Tanzania.

The clove tree, an evergreen, grows 15 to 30 feet (4.6 to 9 meters) tall. The large, smooth, oblong leaves taper to a point. The tree's purplish flowers grow on jointed stalks. The buds of these flowers, called *cloves,* are picked before they open. They are reddish when picked, but turn dark brown when dried. Cloves have a fragrant odor and a warm, sharp taste. They are used chiefly in cooking. An oil from the clove tree's buds and stem is used to flavor desserts and candies and to scent soaps.

David S. Seigler



© Peter Arnold

Clove trees grow in regions that have a warm, wet climate. The trees reach a height of 15 to 30 feet (4.6 to 9 meters).



© W. H. Hodge from Peter Arnold



© George Whitely, Photo Researchers

Cloves, the flower buds of the clove tree, are reddish when picked. Dried cloves, which are used as a spice, are dark brown.

Scientific classification. The clove tree belongs to the myrtle family, Myrtaceae. Its scientific name is *Syzygium aromaticum.*

Clover is a valuable crop used to feed farm animals and to enrich the soil. It contains large amounts of protein and minerals. Clover is used for pasture and to make hay and silage. In addition, clover enriches the soil by adding more nitrogen to the soil than the plant needs for growth (see Nitrogen [Nitrogen and life]). Bacteria that live in clover's roots take nitrogen from the air for the plant's growth and health. Clover uses only some of the nitrogen. After farmers plow clover into the soil, the rest of the nitrogen becomes part of the soil and can be used by other plants.



WORLD BOOK illustration by Lorraine Epstein

Varieties of clover differ chiefly in appearance and in the way they grow. This illustration shows, *from left to right,* white clover, red clover, strawberry clover, and crimson clover.

Clovers are *legumes* (members of the pea family). There are about 250 kinds of true clovers, including the *red, white, strawberry,* and *crimson* species. A type called *subterranean clover* has burs that bury themselves underground. Sweet clover and certain other plants in the pea family are commonly called clovers. However, botanists do not classify them in that group.

The various clovers differ in the manner in which they grow. Some species are *annuals*—that is, they live for only one growing season. Others are *perennials* and can live for more than two growing seasons without being replanted. Species of clover also differ in their appearance. They range from 6 inches to 3 feet (15 to 90 centimeters) in height and have leaves that consist of three to six leaflets. Some people believe that four-leaf clovers bring luck. The plants produce clusters of tiny flowers that are white, yellow, or any of various shades of red. The number of flowers in each cluster ranges from 5 to 200.

Clover probably originated in southwestern Asia Minor and southeastern Europe. Today, both wild and cultivated species grow throughout the world.

Red clover has been used for centuries as a rotation crop. Today, it is used extensively as an animal food and soil-improving crop throughout Europe and northern and central North America. Red clover is generally planted with another crop, such as oats, barley, wheat, grasses, or certain legumes. It has purplish-red flowers and lives for two to three years.

There are three types of red clover—early flowering,



Grant Heilman

A field of red clover provides feed for farm animals. The crop is used for pasture or to make hay and silage. Red clover is also used extensively as a rotation crop.

late flowering, and wild. Early flowering red clover, which produces two to four hay crops a year, is the most commonly cultivated red clover in the United States.

White clover has white or pinkish-white flowers. Its stems spread along the ground and take root in the soil at each *node,* the place where a leaf joins the stem. The roots are short and so cannot reach water far underground. As a result, white clover is grown in regions that have an abundant supply of water. For example, the plant is cultivated in the Eastern United States and Canada, which have plentiful summer rain. Farmers also raise white clover on irrigated land in the western sections of those countries.

Strawberry clover is a valuable pasture crop in the Western United States, especially in areas that have extremely wet and salty soil. Other pasture crops cannot survive in such soil. Strawberry clover has pink flowers that grow in strawberrylike clusters.

Crimson clover is widely cultivated in the Southeast and Pacific Coast regions of the United States. Farmers plant it in the fall to provide protection against erosion during the winter. They use crimson clover for pasture and hay and to improve the soil. The flowers of this clover are dark red and grow in pointed clusters.

Subterranean clover provides winter and early spring pasture in regions that have mild winters. It is raised chiefly in Australia and Chile and in California and Oregon. The seeds of subterranean clover form in burrs that bury themselves in the soil. The plant got its name from this unusual method of growth.

Scientific classification. True clovers belong to the pea family, Leguminosae. Red clover is *Trifolium pratense;* white clover, *T. repens;* strawberry clover, *T. fragiferum;* crimson clover, *T. incarnatum;* and subterranean clover, *T. subterraneum.* Sweet clover is genus *Melilotus.* Vern L. Marble

See also **Flower** (pictures: Flowers of prairies and dry plains; Flowers of summer-dry regions); **Lawn** (picture: Lawn enemies); **Legume; Lespedeza; Shamrock.**

Clovis I, *KLOH vihs* (466?-511), a Frankish king, became the first powerful ruler of the Merovingian dynasty, the founders of the French state. In 481, when Clovis inherited the royal title, he was only one of several Frankish kings. Then, in 486, he defeated the last great Roman army in Gaul. In one campaign after another, he defeated the Alamanni, the Visigoths, and the Burgundians. By 507 he ruled over most of Gaul, western Germany, and the Low Countries of northwestern Europe.

Clovis was the first Germanic king to become an orthodox Christian. Most Germanic rulers either became Arian heretics or remained pagans. By his conversion to Christianity, Clovis won the support of his Catholic subjects, including the clergy. William C. Bark

See also **Fleur-de-lis; Franks; Goths; Merovingian dynasty; Salic law.**

Clown is a type of comic performer who usually works in a circus. To make audiences laugh, most clowns wear funny costumes and makeup and behave in a strange or silly manner. Many clowns develop humorous routines that emphasize playful antics and tricks.

There are two chief types of circus clowns—*auguste* and *whiteface.* Auguste clowns wear extravagant makeup and baggy suits and appear stupid and clumsy. Whiteface clowns are more elegant. They wear white makeup and clown suits and often perform opposite auguste clowns, especially in European circuses. Another type, known as *tramp* clowns, or *hobo* or *Charley* clowns, became popular in American circuses. They resemble tramps, with their tattered suits, unshaven faces, and red noses. They always look sad or lonely.

The first clowns date back to ancient times. They have

Ringling Bros. and Barnum & Bailey Combined Shows, Inc.



Clowns wear colorful, silly costumes and makeup. Most clowns provide comedy at the circus. They often work in groups, performing comic skits and routines. Many clowns are skillful acrobats, jugglers, and magicians.

been called by such names as jester, fool, and buffoon. The word *clown* was popularized in the early 1800's by Joseph Grimaldi, a famous British comic actor. To this day, circus clowns are often called *Joeys* after Grimaldi.

The American circus clown began in the late 1700's as a kind of comedian who stood in front of an audience and told jokes. Because the first circuses were small in size, a single clown could entertain the entire audience with jokes and songs. During that time, clowns ranked among the great stars of the circus. As circuses grew larger in the mid-1800's, individual clowns could no longer entertain audiences. Groups of frolicking clowns replaced the single performing clown. However, in the mid-1900's, such performers as the tramp clown Emmett Kelly continued the earlier tradition. Don B. Wilmeth

See also **Circus** (pictures); **Jester**.

Club is a group of persons organized for some particular purpose, such as social enjoyment and entertainment. A club is usually confined to one community, but there are many state and national groups.

Modern clubs in England and the United States grew out of informal gatherings in the English taverns of the 1500's and 1600's. Groups of literary men and actors, along with the wealthy men who supported them, often met to talk and exchange views. One of the early London clubs met in the Mermaid Tavern in Cheapside. Among its members were Shakespeare, Ben Jonson, Beaumont, Fletcher, and Donne. Jonson established the Apollo Club at the Devil Tavern in 1624 and drew up bylaws for it. In 1764, Dr. Samuel Johnson and Sir Joshua Reynolds founded a club that still exists. It is called the Literary Club or simply The Club, and its first members included such distinguished figures from politics and the arts as David Garrick, Edmund Burke, and Oliver Goldsmith.

Related articles. Clubs and organizations are listed in *World Book* under the key word in the name of the group. Example: **Lions Clubs, International Association of.** See also **Parliamentary procedure**.

Club moss is any one of a group of plants that look somewhat like large mosses. Actually, club mosses are more closely related to ferns and horsetails than they are to mosses. They are also known as *ground pines* or by their scientific name *Lycopodium.* Club mosses were among the first land plants. They appeared on earth about 300 million years ago. Today, the plants are becoming scarce because of their overuse as Christmas greenery. The greatest variety of club mosses grow in tropical regions.





E. R. Degginger

Club mosses have erect green stems and tiny leaves. They are not true mosses, but rather are related to ferns and horsetails.

Club mosses have horizontal stems that spread across the soil. The stems produce roots that grow downward and leafy stems that grow upright. The erect stems may have many branches and are covered with small, needlelike green leaves. *Spores* (tiny reproductive cells) grow on enlarged leaves, which are usually tightly clustered at the tips of branches. Most species of club mosses grow only a few inches or centimeters high.

Scientific classification. Club mosses belong to the club moss family, Lycopodiaceae. They make up the genus *Lycopodium.*

See also **Fern**; **Horsetail**; **Plant** (picture: Lycopsids).

Clubfoot is an abnormal condition of the foot, usually present at birth. But it may develop later as the result of injury or poliomyelitis or other diseases. The condition is also called *talipes* (pronounced *TAL uh peez*). In the commonest form of clubfoot, the foot is bent downward and inward so that the person can walk only on the toes and on the outside of the foot. Sometimes the foot is bent in an upward and outward position so the person can use only the heel for walking. Doctors begin treatment early, sometimes when the baby is only a week old. They use massage, manipulate the foot into position, and use casts to hold the corrected position. In severe cases of clubfoot, surgery may be necessary to correct the condition. William J. Kane

Clumber spaniel is a short, heavy hunting dog. It has a white coat with orange- or lemon-colored markings. Males stand about 20 inches (51 centimeters) high at the shoulder, and weigh as much as 85 pounds (39 kilograms). Females weigh up to 70 pounds (32 kilograms). The Clumber spaniel was probably developed in the late 1700's in England. It is named for Clumber Park, the home of a nobleman who helped develop the breed. The dog is slow but thorough on a hunt. It is not widely used by hunters in the United States.



R. W. Meyer

The Clumber spaniel has a low, heavy body.

Critically reviewed by the Clumber Spaniel Club of America

Clutch. See **Transmission**.

Clyde, River, is the chief commercial waterway in Scotland. The River Clyde rises in the Southern Uplands

of Scotland and flows northward for 100 miles (160 kilometers). It empties into the Firth of Clyde, an inlet of the sea along the west coast. The Falls of Clyde near the town of Lanark once furnished the power for many mills in the Lowlands. Shipbuilding yards once lined the river's banks in Glasgow, Scotland's largest city. The *Queen Mary, Queen Elizabeth,* and other famous ships were built there. Below Glasgow, the river widens into the Firth of Clyde, which is over 50 miles (80 kilometers) long. A. S. Mather

Clydesdale. See **Horse** (Draft horses; picture).

Clymer, George (1739-1813), a Philadelphia merchant and politician, was one of six people who signed both the Declaration of Independence and the Constitution of the United States. He represented Pennsylvania at the Constitutional Convention in Philadelphia in 1787. Clymer later helped win *ratification* (approval) of the Constitution in Pennsylvania.

Clymer was born in Philadelphia. By the early 1770's, he had become a successful merchant there. Clymer also became a leader among Pennsylvanians who supported a movement in the American Colonies for independence from Britain. After the Revolutionary War in America began in 1775, he helped finance and supply American armies. Clymer also served in the Second Continental Congress, which approved the Declaration of Independence in 1776.

From 1785 to 1788, Clymer served in the Pennsylvania legislature. He became a Pennsylvania member of the first U.S. House of Representatives, serving from 1789 to 1791. Clymer also was a founder and president of both the Philadelphia Bank and the Philadelphia Academy of Fine Arts. Richard D. Brown

Clytemnestra, *KLY tuhm NEHS truh,* was a princess in Greek mythology. She married Agamemnon, king of Mycenae, and her sister Helen married his brother Menelaus. Clytemnestra bore a son, Orestes, and three daughters, Iphigenia, Electra, and Chrysothemis. Agamemnon sacrificed Iphigenia to obtain a favorable wind from the gods for the Greek fleet sailing to attack Troy (see **Trojan War**). Clytemnestra hated Agamemnon for sacrificing their daughter and waited for 10 years until the end of the war to take revenge.

While awaiting Agamemnon's return, Clytemnestra fell in love with his cousin Aegisthus. When her husband came back from Troy, Clytemnestra and Aegisthus killed him. Orestes avenged his father's death by killing Clytemnestra and Aegisthus. Cynthia W. Shelmerdine

See also **Agamemnon**.

CN Tower. See **Toronto** (The city); picture.

Cnidarian, *ny DAIR ee uhn,* is the name of a group of soft-bodied water animals. The group includes the freshwater hydras, hydroids, jellyfish, sea fans, sea anemones, and corals. These animals make up the *phylum* (large group) called *Cnidaria.* There are approximately 9,000 species of cnidarians, and most of them live in the sea. Cnidarians are also called *coelenterates.*

The body of a cnidarian may be shaped like a cylinder, a bell, or an umbrella. The mouth opens at one end and leads to a digestive cavity. Every cnidarian has at least two layers of cells that form its body wall. An outer layer makes up the body covering, and an inner layer lines the digestive cavity. Many cnidarians have a third, or middle, layer consisting of a stiff, jellylike material that helps support the animal.

A *medusa,* or jellyfish, is a cnidarian that has a bell- or umbrella-shaped body. Its mouth is at the underside of the body. Tentacles with special stinging cells hang downward from the body's ringlike edge. Medusas swim about freely in the sea.

A *polyp* is a cnidarian that has a body shaped like a hollow cylinder. A polyp lives with one end of its body attached to the sea bottom. The mouth and tentacles extend upward at the other end. Polyps may exist singly or may live together in colonies. Colonies are produced when polyps form buds that detach and become new polyps. Hydras and sea anemones are examples of single polyps, and hydroids and most corals are colony-forming polyps.

Some cnidarians have either medusa or polyp stages, or both, in their life cycles. The medusas are produced from special polyp buds that eventually break free and swim away. Then the medusas produce eggs and sperm that unite and develop into polyps. L. Muscatine

Related articles in *World Book* include:

Coral	Portuguese man-of-war
Hydra	Sea anemone
Jellyfish	Sea fan

Cnossus. See **Knossos**.

Cnut. See **Canute**.

CO detector. See **Carbon-monoxide detector**.

Coach is a four-wheeled vehicle drawn by animals. Coaches served as the main means of public travel before the development of railroads. They were usually pulled by horses, and carried passengers, mail, and express freight. The word *coach* comes from *Kocs,* a town in Hungary where an early coachlike vehicle was built in the 1450's. Emperor Frederick III of Germany built one of the first true coaches in 1474.

Coaches developed from the two-wheeled wagons and carts that people had used since the time of the ancient Egyptians over 5,000 years ago. Their use spread throughout Europe in the 1500's. But travel by horseback was more comfortable, because of the poor roads and riding qualities of coaches. For years, people used coaches mainly for state occasions. The first public coach line in England began about 1640.

John H. White, Jr.

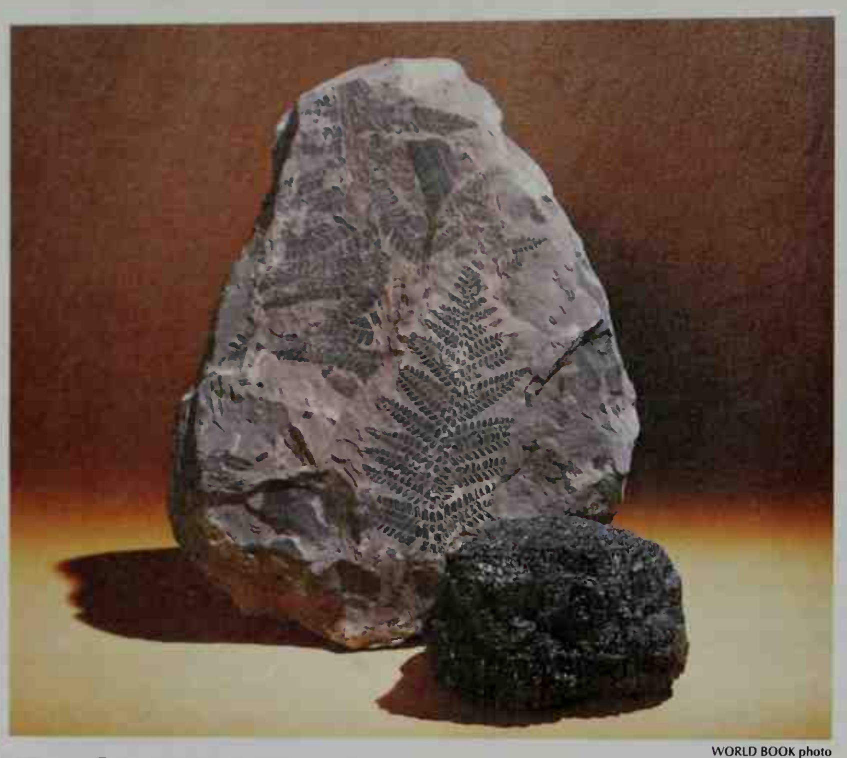
See also **Stagecoach; Wagon; Colonial life in America** (Transportation [picture]); **Transportation** (History [picture: Transportation in early modern times]).

Coach dog. See **Dalmatian**.

Coagulant, *koh AG yuh luhnt,* is any substance that causes a fluid to clot, or thicken. Milk curdles because *rennin,* an enzyme, causes clots to form. One of the most important coagulant actions is the clotting of blood. Scientists have found many blood-clotting factors. The combined action of all of these factors produces a blood clot. If any one clotting factor is missing, the tendency for blood to clot is reduced. Doctors then try to supply the missing substance. For example, in the blood disease *hemophilia,* doctors use an antihemophilic globulin to help the blood to clot. In other diseases, they may give the patient vitamin K or fibrinogen to induce the blood to clot and control hemorrhages.

David Green

See also **Anticoagulant; Blood** (Controlling bleeding); **Fibrin; Hemophilia; Vitamin** (Vitamin K).



Fossil ferns and a lump of coal, *left,* were both formed from the remains of plants that died many millions of years ago. While the plants lived, they stored up energy from the sun. The plants that became fossils gave up their store of energy in the process. Only the outline of their appearance remains. But the energy of the coal-forming plants is preserved in the coal. When the coal is burned, it releases this energy in the form of heat.

WORLD BOOK photo

Coal

Coal is a black or brown rock that can be ignited and burned. As coal burns, it produces useful energy in the form of heat. People use this heat to warm buildings and to make or process various products. But the main use of the heat from coal is the production of electricity. Coal-burning power plants supply more than half the electricity used in the United States and nearly half that is used throughout the world. Another major use of coal is the production of *coke,* a raw material in the manufacture of iron and steel. In addition, the coke-making process provides raw materials used to make such products as drugs, dyes, and fertilizers.

Coal was once the main source of energy in all industrial countries. Coal-burning steam engines provided most of the power in these countries from the early 1800's to the early 1900's. Since the early 1900's, petroleum and natural gas have become the leading sources of energy in much of the world. Unlike coal, petroleum can be easily made into gasoline and the other fuels needed to run transportation equipment. Natural gas has replaced coal as a source of heat for some applications. However, people are rapidly using up the world's supplies of petroleum and natural gas that can be removed from the ground economically. If the present rates of use continue, little may remain of these supplies by about 2050. By contrast, the world's supply of coal can last more than 250 years at the present rate of use. Increased use of coal, especially for producing electricity, could relieve a shortage of gas and oil.

Historically, the burning of coal has been a major cause of air pollution. But since the 1970's, air pollution from coal burning has declined despite increases in coal consumption. This is due partly to the use of air pollution control systems by utilities and industries, as required by the United States Clean Air Act of 1970. It is also due to better coal-cleaning procedures and the use of coals with low sulfur content.

In the past, few jobs were harder or more dangerous than that of an underground coal miner. During the 1800's, many miners had to work underground 10 or more hours a day, six days a week. Picks were almost the only equipment they had to break the coal loose. The miners shoveled the coal into wagons. In many cases, children as young as 10 years of age hauled the coal from the mines. Women worked as loaders and haulers. Over the years, thousands of men, women, and children were killed in mine accidents. Thousands more died of lung diseases from breathing coal dust.

Today, machines do most of the work in coal mines. Mine safety has been improved, work hours have been shortened, and child labor is prohibited. The death rate from U.S. mine accidents has dropped greatly since 1900. However, coal mining remains a hazardous job.

This article discusses how coal was formed, where it is found, its uses, and how it is mined. The article also discusses the cleaning and shipping of coal, the coal industry, and the history of the use of coal.

Joseph W. Leonard III, the contributor of this article, is Professor of Mining Engineering at the University of Kentucky. The article was critically reviewed by the National Coal Association.

Coal developed from the remains of plants that died 400 million to 1 million years ago. For this reason, it is often referred to as a *fossil fuel.* The coal-forming plants probably grew in swamps. As the plants died, they gradually formed a thick layer of matter on the swamp floor. Over the years, this matter hardened into a substance called *peat.* In time, the peat deposits became buried under sand or other mineral matter. As the mineral matter accumulated, some of it turned into such rocks as sandstone and shale. The increasing weight of the rock layers and of the other overlying materials began to change the peat into coal. Coal, sandstone, and other rocks formed from deposited materials are called *sedimentary rocks.*

The first stage in the formation of coal produces a dark brown type of coal called *lignite.* Lignite develops from buried peat deposits that have been under pressure. The pressure results from the weight of the overlying materials and from movements within the earth's crust. As the pressure increases, lignite turns into *subbituminous coal.* Under greater pressure, subbituminous coal turns into a harder coal called *bituminous coal.* Intense pressure changes bituminous coal into *anthracite,* the hardest of all coals. Bituminous coal is also known as *soft coal;* anthracite, as *hard coal.*

Anthracites are the oldest coals in most cases, and lignites are the youngest. Some anthracites began to form as long as 400 million years ago. Some lignites developed within the last 1 million years.

The greatest period of coal formation occurred during a time in the earth's history called the *Carboniferous Period,* from about 360 million to 286 million years ago.. During the Carboniferous Period, swamps covered much of the earth. Tall ferns and other treelike plants grew in the swamps and produced huge amounts of peat-forming matter after they died.

Today's plentiful deposits of bituminous coal developed largely from the vast peat deposits formed during the Carboniferous Period. It took about 3 to 7 feet (0.9 to 2.1 meters) of compact plant matter to produce a bed of bituminous coal 1 foot (0.3 meter) thick.

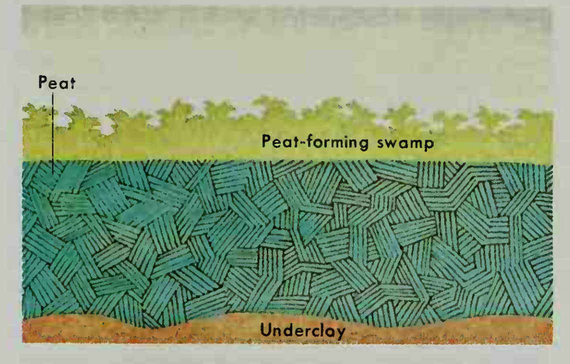
Plant materials are still accumulating in some parts of Maine, the Okefenokee Swamp in Georgia and Florida, and other swampy locations. These materials could eventually develop into coal.

Coal beds are also called *coal seams* or *coal veins.* Present-day seams range in thickness from less than 1 inch (2.5 centimeters) to 400 feet (120 meters) or more. The thickest seams are subbituminous coals and lignites. Many coal deposits consist of two or more seams separated by layers of rocks. These formations were produced by new coal-forming swamps developing over buried ones. Each new swamp became buried and developed into a separate seam of coal.

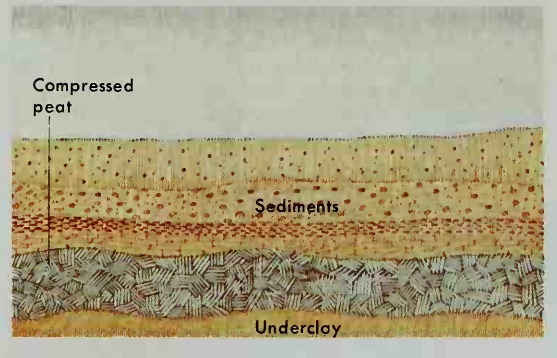
Some coal beds lie nearly parallel to the earth's surface. Other beds have been tilted by earth movements and lie at an angle to the surface. Most of the deepest beds consist of anthracites or bituminous coals. In many cases, earth movements have uplifted deep anthracite and bituminous beds to a position nearer the surface. Such movements also account for coal seams in hills and mountains.

The development of coal

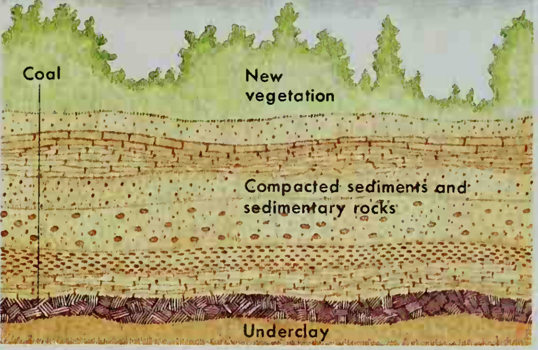
The formation of coal involved three main steps. (1) The remains of dead plants turned into a substance called *peat.* (2) The peat became buried. (3) The buried peat was subjected to great pressure. After thousands or millions of years under pressure, the peat turned into coal. Each of these steps is illustrated below.



A thick layer of peat developed as plant matter accumulated and hardened on the floor of a swamp. The matter built up as plants that grew in the swamp died and sank to the bottom. Peat-forming swamps once covered much of the earth.



Deposits of loose mineral matter, called *sediments,* completely covered the peat bed. As these sediments continued to pile up over the bed, they compressed the peat.



WORLD BOOK diagrams by Jean Helmer

Pressure on the peat increased as the sediments became more compact and heavier. Some sediments hardened into rock. The increasing pressure turned the peat into coal.

Where coal is found

Coal is found on every continent. Deposits occur as far north as the Arctic and as far south as Antarctica. Some coal deposits occur off ocean coastlines. However, deep underwater deposits have little value at this time because they are difficult to mine.

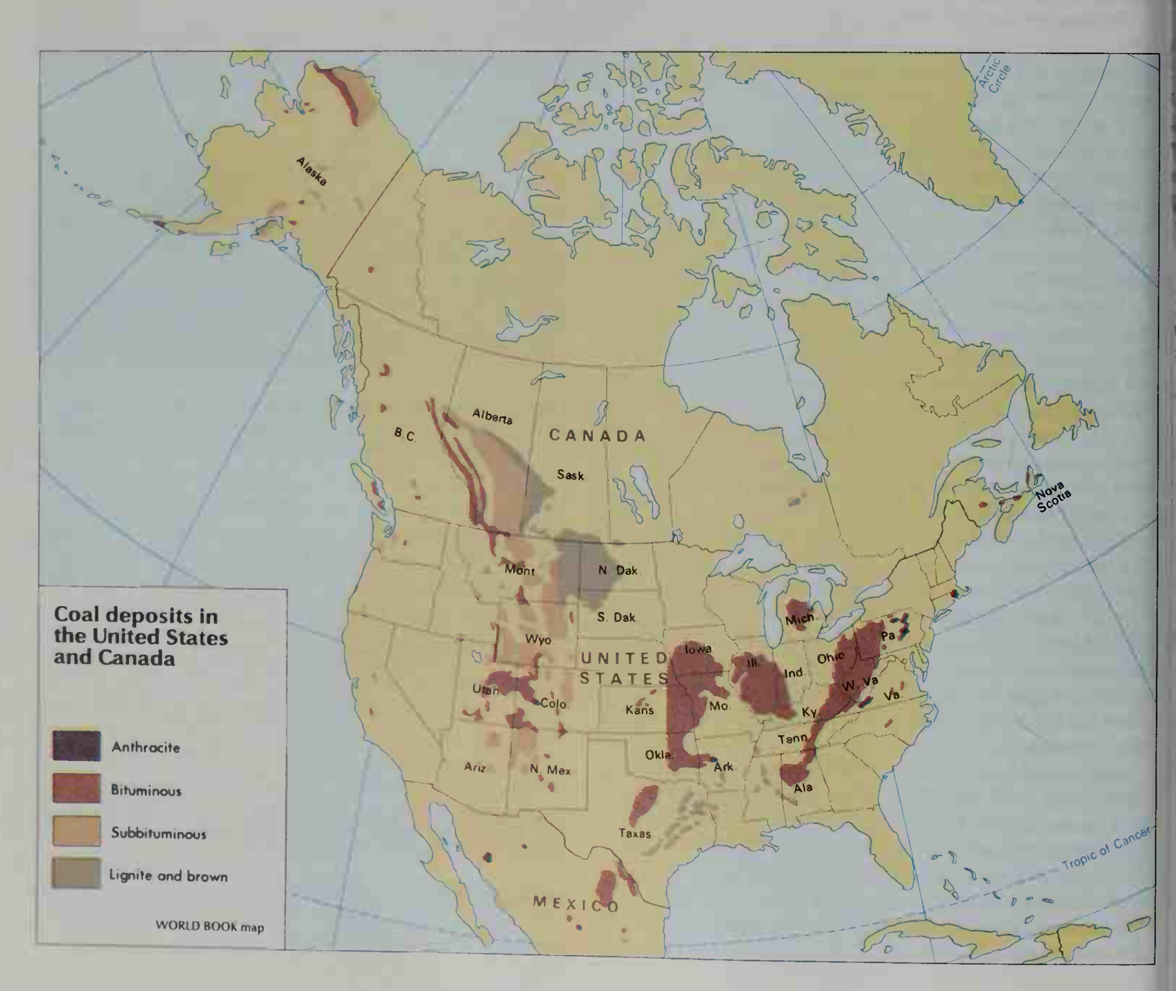
Coal deposits that can be mined profitably are called *coal reserves.* In most cases, a coal seam must be at least 24 inches (61 centimeters) thick for mining engineers to class it as a reserve. Some long-range estimates of coal reserves include beds 12 to 24 inches (30 to 61 centimeters) thick. But such thin beds would probably be mined only after more productive deposits were exhausted. Most estimates of coal reserves include only tested deposits. The reserves may actually be somewhat larger or smaller than the estimates.

To estimate coal reserves, mining engineers drill into the ground in suspected coal-bearing areas. A drill brings up samples of the rock formations in the order in which they occur. The depth and thickness of a coal seam can thus be estimated. By taking a number of such samples, engineers can estimate the extent of a particular deposit. A large area of tested reserves is called a *coal field.*

World coal reserves. No reliable estimates exist for the total amount of coal that lies beneath the earth's surface. The world's *proved recoverable reserves* of coal total over 1.1 trillion short tons (1 trillion metric tons). This figure represents the amount of coal that can be profitably recovered from known deposits with current technology. Most of the proved recoverable reserves are in Australia, China, Germany, India, Indonesia, Poland, Russia, South Africa, and the United States.

Location of U.S. and Canadian reserves. About half of all U.S. coal reserves lie in the eastern half of the nation, from the Appalachian Highlands to the eastern edge of the Great Plains. The rest of the reserves are in the western part of the country, especially the Rocky Mountain States, the northern Great Plains, and Alaska. The eastern reserves include nearly all the nation's anthracite deposits. They also include more than four-fifths of its bituminous deposits. The western reserves include almost all the subbituminous coal and lignite in the United States.

Canada's coal reserves consist chiefly of bituminous coal. The nation also possesses large fields of subbituminous coal and lignite. However, these deposits are smaller than the bituminous deposits. More than 95 percent of Canada's reserves are in the country's western provinces—British Columbia, Alberta, and Saskatchewan.



The way in which coal is used depends on its chemical composition and moisture content. Coal is often referred to as a mineral. But unlike a true mineral, coal has no fixed chemical formula. All coal consists of certain solids and moisture. The solids are composed chiefly of the elements carbon, hydrogen, nitrogen, oxygen, and sulfur. However, coal varies widely in the amount of each element it contains as well as in the amount of moisture it contains. No two deposits of coal are exactly alike in their makeup.

Coal is usually classified according to how much carbon it contains. Coal can thus be grouped into four main classes, or *ranks:* (1) anthracites; (2) bituminous coals; (3) subbituminous coals; and (4) lignites, or brown coals. The carbon content of the coals decreases down through the ranks. The highest-ranking anthracites contain about 98 percent carbon. The lowest-ranking lignites have a carbon content of only about 30 percent. The amount of moisture in the coals can be as low as less than 1 percent, in anthracites and bituminous coal, and as high as 45 percent, in lignites. High-moisture subbituminous and lignite coals have a lower *heating value* than do anthracites and bituminous coals. Heating value refers to the amount of heat that is produced by a given amount of coal when it is burned.

Bituminous coals are by far the most plentiful. They are also the most widely used of the major ranks of coals. They have a slightly higher heating value than do anthracites and are the only coals suited to making coke. Anthracites are slow to ignite. They also burn too slowly to be suitable for industrial purposes such as the generation of electric power. Anthracites are also the least plentiful of the four ranks of coals. About 2 percent of the coal in the United States is anthracite.

Coal as a fuel

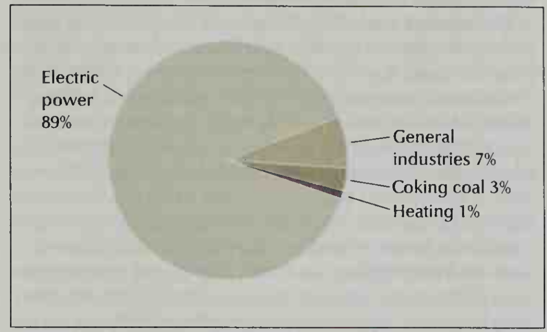
Coal is a useful fuel because it is abundant and has a relatively high heating value. However, coal has certain impurities that limit its usefulness as a fuel. These impurities include sulfur and various minerals. As coal is burned, most of the sulfur combines with oxygen and forms a poisonous gas called *sulfur dioxide.* Most of the minerals turn into ash. The coal industry refers to ash-producing substances in coal as ash even before the coal is burned.

Coal known as *low-sulfur coal* can be burned in fairly large quantities without adding harmful amounts of sulfur dioxide to the air. *Medium-* and *high-sulfur coals* can cause serious air pollution if burned in large quantities without proper safeguards.

The United States Department of Energy (DOE) classifies sulfur content according to the weight of the sulfur in a sample of coal that can produce 1 million British thermal units (Btu's) of heat. Such a sample is low-sulfur coal if it contains 0.60 pounds (0.272 kilograms) or less of sulfur, medium-sulfur coal if its sulfur content is 0.61 to 1.67 pounds (0.277 to 0.758 kilograms), and high-sulfur coal if it contains 1.68 pounds (0.763 kilograms) or more of sulfur.

Some of the ash produced by burning powdered coal may also escape into the air. Like sulfur dioxide, such *fly ash* can contribute to air pollution. However, devices have been developed to trap fly ash in smokestacks and so prevent it from polluting the air.

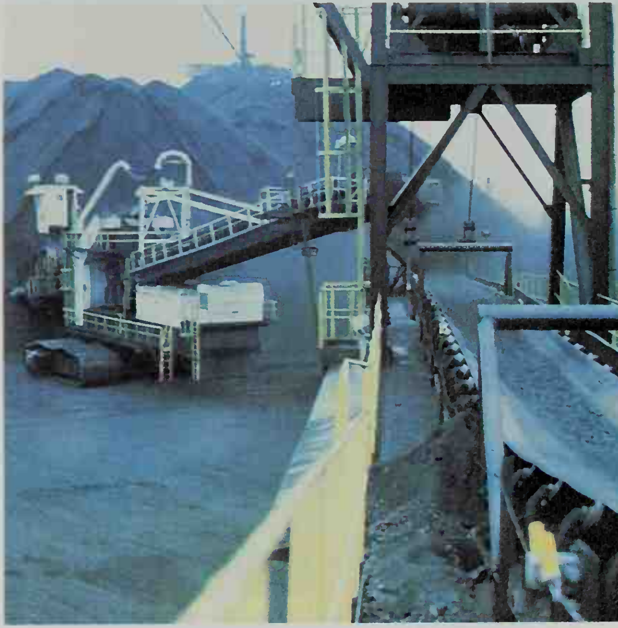
Uses of coal in the United States



Figures are for 1998. Source: U.S. Energy Information Administration.

Coal is used as a fuel chiefly in the production of electric power. Electric power plants use nearly 90 percent of the coal mined in the United States.

Electric power production. Most electric power plants are *steam-turbine plants.* All nuclear power plants and almost all plants fueled by coal, gas, or oil are steam-turbine plants. They use high-pressure steam to generate electric power. The steam spins the wheels of turbines, which drive the generators that produce power. Steam-turbine plants differ mainly in how they create heat to make steam. Nuclear plants create the heat by splitting uranium atoms. Other plants burn coal, gas, or fuel oil. Steam plants produce about 70 percent of the electric power used in the United States. Coal-burning



National Coal Association

A conveyor system at a power plant removes coal from a stockpile and carries it to the plant's boilers. Coal-burning power plants produce most of the electric power used in the world.

plants account for most of this output. See **Electric generator; Electric power; Turbine.**

Bituminous coals have long been the preferred coals for electric power production because they are the most plentiful coals and have the highest heating value. Subbituminous coals and lignites have the lowest heating value. However, nearly all the subbituminous coal and about 90 percent of the lignite in the United States have a low sulfur content. On the other hand, about 50 percent of the nation's bituminous coal has a medium- or high-sulfur content. To meet federal and state pollution standards, power plants are burning more subbituminous coal and lignite. However, these coals cause problems for industry because they quickly lose their moisture, break up, and become dusty. This dustiness makes them difficult to handle and transport.

Other uses of coal as a fuel. In parts of Asia and Europe, coal is widely used for heating homes and other buildings. In the United States, natural gas and fuel oil have almost entirely replaced coal as a domestic heating fuel. However, the rising cost of oil and natural gas has led some factories and other commercial buildings to switch back to coal. Anthracites are the cleanest-burning coals, and so they are the preferred coals for heating homes. However, anthracites are also the most expensive coals. For this reason, bituminous coals are often preferred to anthracites for heating factories and other commercial buildings. Subbituminous coals and lignites have such a low heating value that they must be burned in large amounts in order to heat effectively. As a result, they are seldom used for domestic heating.

In the past, coal also provided heat for the manufacture of a wide variety of products, from glass to canned foods. Since the early 1900's, manufacturers have come to use natural gas in making most of these products. Coal is used mainly by the cement and paper industries. However, some industries have switched back to coal to avoid paying higher prices for natural gas.



National Coal Association

A coking plant heats coal in airtight ovens to make *coke,* an essential raw material in the manufacture of steel. This batch of red-hot coke is being released from an oven into a railcar. The car will carry it to another part of the plant to cool.

Coal as a raw material

Many substances made from coal serve as raw materials in manufacturing. Coke is the most widely used of these substances. Coke is made by heating bituminous coal to about 2000 °F (1100 °C) in an airtight oven. The lack of oxygen prevents the coal from burning. The heat changes some of the solids in the coal into gases. The remaining solid matter is coke—a hard, foamlike mass of nearly pure carbon. It takes about 1 $\frac{1}{2}$ short tons (1.4 metric tons) of bituminous coal to produce 1 short ton (0.9 metric ton) of coke. For an illustration of the coke-making process, see **Coke.**

The coal used to make coke is called *coking coal.* To be suitable for coking, the coal must have various characteristics, such as a low-sulfur content and a specified amount of ash. Only certain types of bituminous coals have all the necessary characteristics.

About 90 percent of the coke produced in the United States is used to make iron and steel. Most coking plants are a part of steel mills. The mills burn coke with iron ore and limestone to change the ore into the pig iron required to make steel. It takes about 900 pounds (410 kilograms) of coke to produce 1 short ton (0.9 metric ton) of pig iron. For a description of the role of coke in the iron-making process, see the *World Book* article **Iron and steel** (Raw materials; illustration: How a blast furnace operates).

The coke-making process is called *carbonization.* Some of the gases produced during carbonization turn into liquid ammonia and coal tar as they cool. Through further processing, some of the remaining gases change into light oil. Manufacturers use the ammonia, coal tar, and light oil to make such products as drugs, dyes, and fertilizers. Coal tar is also used for roofing and for road surfacing.

Some of the gas produced during carbonization does not become liquid. This *coal gas,* or *coke oven gas,* burns like natural gas. But coal gas has a lower heating value and, unlike natural gas, gives off large amounts of soot as it burns. Coal gas is used chiefly at the plants where it is produced. Coal gas provides heat for the coke-making and steel-making processes.

Gas can be produced from coal directly, without carbonization, by various methods. Such methods are known as *gasification.* The simplest gasification method involves burning coal in the presence of forced air or steam. The resulting gas, like coke oven gas, has a low heating value and produces soot. It is used chiefly in some manufacturing processes. Coal can be used to make high-energy gas and such high-energy liquid fuels as gasoline and fuel oil. But the present methods of producing these fuels from coal are costly and complex. The section *The coal industry* discusses how researchers are working to develop cheaper and simpler methods.

Coal mines can be divided into two main groups: (1) surface mines and (2) underground mines. In most cases, surface mining involves stripping away the soil and rock that lie over a coal deposit. This material is known as *overburden.* After the overburden has been removed, the coal can easily be dug up and hauled away. Underground mining involves digging tunnels into a coal deposit. Miners must go into the tunnels to remove the coal.

Surface mining is usually limited to coal deposits within 100 to 200 feet (30 to 61 meters) of the earth's surface. The more overburden that must be removed, the more difficult and costly surface mining becomes. Most coal deposits deeper than 200 feet are mined underground. Surface mines produce about 60 percent of the coal mined in the United States. Underground mines produce the rest.

Surface mining

Nearly all surface mining is *strip mining*—that is, mining by first stripping away the overburden. Many coal seams are exposed on the sides of hills or mountains. In some cases, these seams are mined from the surface without removing any overburden. Miners use machines called *augers* to dig out the coal. This method of surface mining is known as *auger mining.*

Strip mining depends on powerful machines that dig up the overburden and pile it out of the line of work. The dug-up overburden is called *spoils.* In time, a strip mine and its spoils may cover an enormous area. The digging up of vast areas of land has caused serious environmental problems in the past. As a result, the U.S. government now requires that all new strip-mined land be *reclaimed*—that is, returned as closely as possible to its original condition. Strip mining thus involves methods of (1) mining the coal and (2) reclaiming the land.

Mining the coal. Most strip mines follow the same basic steps to produce coal. First, bulldozers or loaders clear and level the vegetation and soil above the mining area. Many small holes are then drilled through the rocky overburden to the coal bed. Each hole is loaded with explosives. The explosives are set off, shattering the rock in the overburden. Giant power shovels or other earthmoving machines then clear away the broken rock. Some of these earthmovers are as tall as a 20-story building and can remove more than 3,500 short tons (3,180 metric tons) of overburden per hour. After a fairly large area of coal is exposed, explosives may be used again. Coal-digging machines then scoop up the coal and load it into trucks. The trucks carry the coal from the mine.

Although most strip mines follow the same basic steps, strip-mining methods vary according to whether the land is flat or hilly. Strip mining can thus be classed as either (1) area mining or (2) contour mining. Area mining is practiced where the land is fairly level. Contour mining is practiced in hilly or mountainous country. It involves mining on the *contour*—that is, around slopes.

In area mining, an earthmover digs up all the broken overburden from a long, narrow strip of land along the edge of the coal field. The resulting deep ditch is referred to as a *cut.* As the earthmover digs the cut, it piles the spoils along the side of the cut that is away from the mining area. The piled spoils form a ridge called a *spoil bank.* After the cut is completed, the coal is dug, loaded into trucks, and hauled away. The earthmover then digs an identical cut alongside the first one. It piles the spoils from this cut into the first cut. This process is repeated over and over across the width of the coal field until all of the coal has been mined. The spoil banks form a series of long, parallel ridges on the land that can later be leveled.

Area mining is impractical where coal seams are embedded in hills. If a seam lies near the top of a hill, an earthmover may simply remove the hilltop and so expose the coal. If a seam lies near the base of a hill, it must be mined on the contour.

In contour mining, an earthmover removes the shattered overburden immediately above the point where a seam *outcrops* (is exposed) all around a hill. The resulting cut forms a wide ledge on the hillside. The spoils may be stored temporarily on the hillside or used to fill in the cuts. After the exposed coal has been mined and hauled away, the earthmover may advance up the slope and dig another cut immediately above the first one. However, the depth of the overburden increases sharply with the rise of the slope. After the first or second cut, the overburden may be too great for a coal company to



Bucyrus-Erie Company

Strip mining depends on giant earthmoving machines like the one at the top of this picture. The earthmover strips away the soil and rock that lie over a coal deposit. A coal-digging machine, *center,* then scoops up the coal and loads it into a truck.

remove profitably. But if the seam is thick enough, a company may dig an underground mine to remove the rest of the coal.

Reclaiming the land. The chief environmental problems that strip mining can cause result from burying fertile soil under piles of rock. The rocks tend to give off acids when exposed to moisture. Rainwater runs down the bare slopes, carrying acids and mud with it. The runoff from the slopes may wash away fertile soil in surrounding areas and pollute streams and rivers with acids and mud.

The first step in reclaiming strip-mined land is to reduce the steep slopes formed by the spoils. The spoil banks created by area mining can be leveled by bulldozing. The spoils from contour mining can be used to fill in the cuts in the hillsides. As much topsoil as possible should then be returned to its original position so that the area can be replanted.

Mining companies now reclaim all strip-mined land, much of which has been turned into farms and recreation areas. In 1977, the U.S. Congress passed a law requiring mine owners to reclaim all the land they use for strip mining after 1978. In every case, the mine owners must restore the land as nearly as possible to its original condition. Many older strip-mined lands have not been reclaimed. But since 1977, the government has collected over $3 billion in fees from coal producers to reclaim these older mines.

Auger mining. A coal auger is a machine shaped like an enormous corkscrew. It bores into the side of a coal outcrop on a slope and twists out the coal in chunks. Contour mines often use augers when the overburden in a slope is too great to remove. An auger can penetrate the outcrop and recover coal that could not otherwise be mined. Some augers can bore 200 feet (61 meters) or more into a hillside.

Companies often employ auger mining to mine outcrops of high-quality coal that cannot be mined economically by other methods. However, auger mining can recover only a small portion—as little as 15 percent—of the coal in a seam. The method is best used in combination with contour mining.

Underground mining

Underground mining is more hazardous to workers than surface mining. The miners may be injured or killed by cave-ins, falling rocks, explosions, and poisonous gases. To prevent such disasters, every step in underground coal mining must be designed to safeguard the workers.

Underground mining generally requires more human labor than surface mining. But even so, underground mines are highly mechanized. Machines do all the digging, loading, and hauling in nearly all the mines. Nonmechanized mines produce only about 1 percent of the coal mined underground in the United States.

In most cases, miners begin an underground mine by digging two access passages from the surface to the coal bed. One passage will serve as an entrance and exit for the miners and their equipment. The other passage will be used to haul out the coal. Both passages will also serve to circulate air in and out of the mine. As the mining progresses, the workers dig tunnels from the access passages into the coal seam.

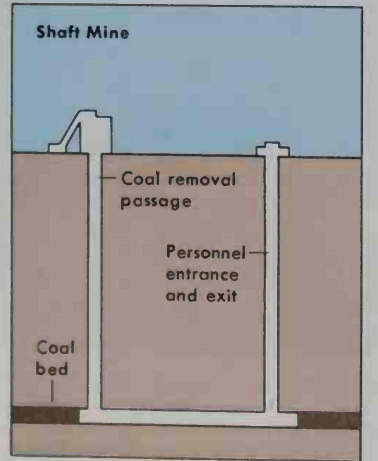
Underground mines can be divided into three main groups according to the angle at which the access passages are dug into the ground. The three groups are (1) shaft mines, (2) slope mines, and (3) drift mines. Some mines have two or all three types of passages.

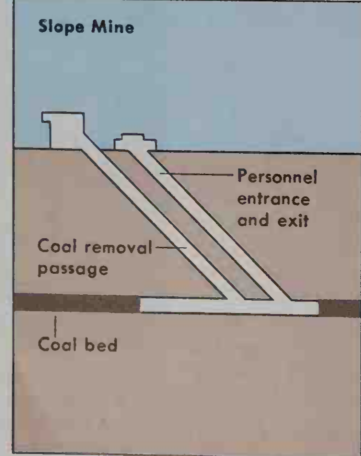
In a shaft mine, the access passages run straight down from the surface to the coal seam. The entrance and exit shaft must have a hoist. Most mines under more than 700 feet (210 meters) of cover are shaft mines. In a slope mine, the access passages are dug on a slant. They may follow a slanting seam or slant down through the cover to reach the seam. Drift mines are used to mine seams of coal that outcrop in hills or mountains. The access passages for these mines are dug into a

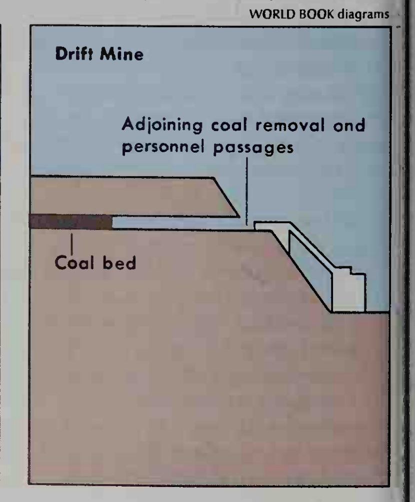
Kinds of underground mines

There are three main kinds of underground mines: (1) shaft mines, (2) slope mines, and (3) drift mines. In a shaft mine, the entrance and exit passages are vertical. In a slope mine, they are dug on a slant. In a drift mine, the passages are dug into the side of a coal bed exposed on a slope.

WORLD BOOK diagrams







seam where the coal bed outcrops on a slope.

Two main systems of underground mining are used: (1) the room-and-pillar system and (2) the longwall system. Each system has its own set of mining techniques. Either system may be used in a shaft, slope, or drift mine. The room-and-pillar system is by far the more common system of underground mining in the United States. The longwall system is more widely used elsewhere, especially in European countries.

The room-and-pillar system involves initially leaving pillars of coal standing in a mine to support the overburden. Miners may begin a room-and-pillar mine by digging three or more long, parallel tunnels into the coal seam from the access passages. These tunnels are called *main entries*. In most cases, the walls, or ribs, of coal separating the main entries are 40 to 80 feet (12 to 24 meters) wide. Cuts are made through each wall every 40 to 80 feet. The cuts thus form square or rectangular pillars of coal that measure 40 to 80 feet on each side. The coal dug in building the entries is hauled to the surface.

The pillars help support the overburden in the main entries. But in addition, the entry roofs must be bolted to hold them in place. To bolt the roof, the miners first drill holes 3 to 6 feet (0.9 to 1.8 meters) or more into the roof. They then anchor a long metal bolt into each hole and fasten the free end of each bolt to the roof. The bolts bind together the separate layers of rock just above the roof to help prevent them from falling. The miners must also support the roof in all other parts of the mine as they are developed.

A conveyor belt or a railroad track is built in one of the main entries to carry the coal to the access passages. A railroad may also transport the miners along the main entries. At least two main entries serve chiefly to circulate air through the mine. The mine may also need such facilities as water drainage ditches, gas drainage pipes, compressed air pipes, water pipes, and electric power cables. These facilities are built into the main entries and later extended to other parts of the mine.

After the main entries have been constructed, the miners dig sets of *subentries* at right angles from the main entries into the coal seam. Each set of subentries consists of three or more parallel tunnels, which serve the same purposes as the main entries. Cuts are made through the walls separating these tunnels, forming pillars like those between the main entries. At various points along each set of subentries, the miners dig *room entries* at right angles into the seam. They then begin to dig *rooms* into the seam from the room entries.

As the miners enlarge a room, they leave pillars of coal to support the overburden. A room is mined only a certain distance into the seam. When this distance is reached, the miners may remove the pillars. The room roof collapses as the pillars are removed, and so they must be removed in *retreat*—that is, from the back of the room toward the front. The miners' exit from the room thus remains open as the roof falls. Pillars are also sometimes removed from entries. Like room pillars, they must be removed in retreat to protect the miners.

All room-and-pillar mining involves leaving some pillars in place. Room-and-pillar mines differ, however, in their mining methods. Mechanized room-and-pillar mines use two main methods: (1) the conventional mechanized method and (2) continuous mining.

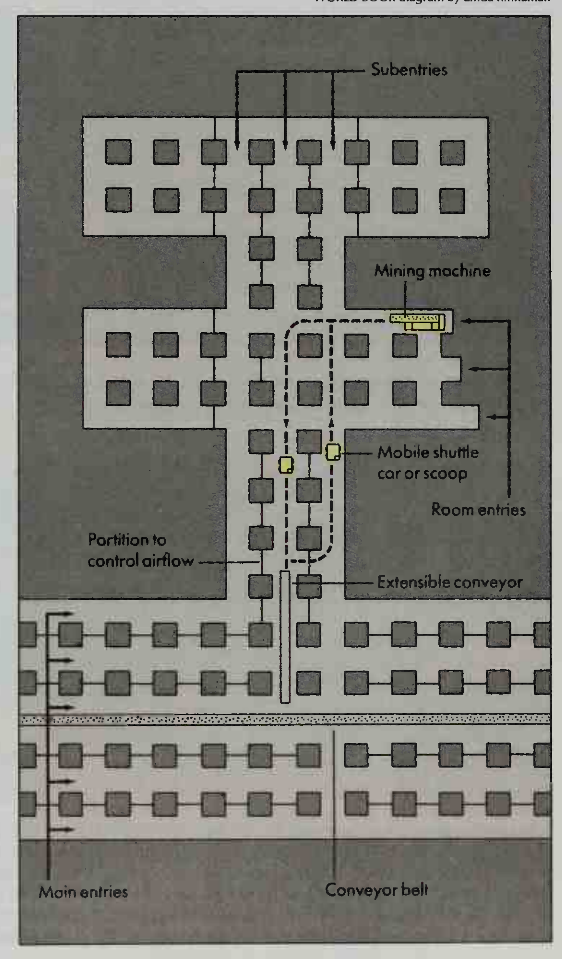
The conventional mechanized method produces about 10 percent of the coal mined underground in the United States. This method was more widely practiced during the 1930's and 1940's than it is today. During the 1930's, it largely replaced the earlier method of digging coal by hand. Since about 1950, continuous mining has increasingly replaced the conventional method.

The conventional method involves five main steps. (1)

The room-and-pillar system

Most underground mines in the United States use the *room-and-pillar system* of mining. First, the miners dig tunnels called *main entries* into the coal bed from the entrance and exit passages. They then dig sets of *subentries* into the bed from the main entries and sets of *room entries* into the bed from the subentries. Pillars of coal are left standing in all the entries to support the mine roof. As the room entries are extended, they create large *panels* of coal. The miners eventually dig *rooms* into the panels to recover as much coal as possible from the bed. This floor plan of a room-and-pillar mine shows how the entries are developed.

WORLD BOOK diagram by Linda Kinnaman



Types of underground-mining equipment

The type of equipment that an underground mine requires depends on the method of mining it uses. Mechanized mines use three main methods: (1) the conventional method, (2) continuous mining, and (3) longwall mining. Each of the three methods calls for a different type of equipment.

WORLD BOOK illustrations by Robert Addison







Conventional-mining equipment. The conventional method of mining involves a series of steps, three of which require special machinery. First, a cutting machine, *left,* cuts a deep slit along the base of the coal *face* (coal exposed on the surface of a mine wall). Another machine, *center,* drills holes into the face. Miners load the holes with explosives and then set the explosives off. The undercutting along the bottom of the face causes the shattered coal to fall to the floor. A loading machine, *right,* gathers the coal onto a conveyor belt.



Continuous-mining equipment eliminates the series of steps in mining a face. A continuous mining machine, *right,* gouges out the coal and loads it onto a shuttle car in one operation.



Longwall-mining equipment. Longwall mining differs from the other methods of underground mining in its system of roof support. The other methods are used only in room-and-pillar mines, where pillars of coal are left to support the mine roof. In the longwall method, movable steel props support the roof over one long coal face. The miners move a cutting machine back and forth across the face, shearing off coal. The coal falls onto a conveyor. As the miners advance the cutter into the bed, the roof supports are moved forward. The roof behind the miners is allowed to fall.



Consolidation Coal Company

A worker operating a continuous miner can produce about 2 short tons (1.8 metric tons) of coal per hour. These machines dig about 60 percent of the U.S. coal mined underground.

A machine that resembles a chain saw cuts a long, deep slit, usually along the base of the coal face. (2) Another machine drills a number of holes into the face. (3) Each hole is loaded with explosives. The explosives are set off, shattering the coal. The undercutting along the bottom of the face causes the broken coal to fall to the floor. (4) A machine loads the coal onto shuttle cars, scoops, or a conveyor. (5) Miners bolt the roof that has been exposed by the blast.

A separate crew of miners carries out each of the five steps. After a crew has completed its job on a particular face, the next crew moves in. The miners can thus work five faces of coal at a time. But there are frequent pauses in production as the crews change places.

Continuous mining accounts for about 60 percent of the output of U.S. underground coal mines. The method uses machines called *continuous miners.* A continuous miner gouges the coal from the *coal face*—that is, the coal exposed on the surface of a wall. One worker operating a continuous miner can produce about 2 short tons (1.8 metric tons) of coal per hour. The machine automatically loads the coal onto shuttle cars or a conveyor belt, which carries it to the railroad or conveyor in the main entries.

A continuous miner can usually dig and load coal much faster than the coal can be hauled out of a mine. The machine can work faster than the haulage, roof-bolting, ventilation, construction, and drainage systems can be completed. As a result, a continuous miner must frequently be stopped to allow the other mine systems to catch up.

The longwall system of underground mining involves digging main tunnels or entries like those in a room-and-pillar mine. However, the coal is mined from one long face, called a *longwall,* rather than from many short faces in a number of rooms.

A longwall face is about 300 to 700 feet (91 to 210 meters) long. The miners move a powerful cutting machine back and forth across the face, plowing or shearing off the coal. The coal falls onto a conveyor belt. Movable steel props support the roof over the length of the immediate work area. As the miners work the machine farther into the seam, the roof supporters are advanced. The roof behind the miners is allowed to fall. After a face has been dug out 4,000 to 6,000 feet (1,200 to 1,800 meters) into the seam, a new face is developed and mined. This process is repeated over and over until as much coal as possible has been removed from the seam.

The longwall system originated in Europe. Underground mines in Europe are much deeper, on the average, than U.S. underground mines. The pressure of the overburden becomes intense in an extremely deep mine. Longwall mining relieves the pressure by allowing the roof to cave in throughout most of a mine. In a European longwall mine, the roof remains in place only over the main entries, over the longwall face, and over two tunnels leading to the face. The mines can thus recover up to 90 percent of the coal in a seam.

Mine safety laws in the United States require longwall mines to have fully developed subentries as well as main entries. Thus U.S. longwall mining includes some of the main features of the room-and-pillar system. One kind of longwall mining is called the *retreating longwall system.* This type of mining uses the room-and-pillar system to reach and expose the long coal face. Longwall equipment then mines the coal. These mines are much more productive than room-and-pillar mines because less coal is left in place.

Longwall mines produce about 30 percent of the coal mined underground in the United States. However, more and more U.S. mines are adopting longwall techniques. A few American mines have adopted another variation of the longwall method called *shortwall mining.* A shortwall face is only about 150 to 200 feet (46 to 61 meters) long, and it is mined with continuous-mining machines rather than with longwall equipment. This system, which was developed in Australia, is suited to coal seams whose structure prevents them from being divided into long faces.

Cleaning and shipping coal

Some coal is shipped to buyers exactly as it comes from the mine without any processing. In the coal industry, such coal is called *run-of-mine coal.* It ranges in size from fine particles to large chunks. About 10 percent of the coal sold by U.S. companies is run-of-mine coal.

The two largest users of coal, the electric power industry and the coking industry, have definite quality requirements for the coal they buy. Much run-of-mine coal does not meet these requirements because it is the incorrect size or contains unacceptable amounts of impurities. As a result, mining companies sort their coal according to size and *clean* the coal to remove impurities. The companies sort about 50 percent of their coal without cleaning it, and both sort and clean 40 percent of the coal.

Companies sort coal by crushing large pieces and passing the coal through a screening device. The following section describes the cleaning process.

Cleaning coal. Mining companies clean coal in *preparation plants.* Most large coal mines have a preparation plant on the mine property. The plants use a variety of machines and other equipment to remove the impurities from coal.

Ash and sulfur are the chief impurities in coal. The ash consists chiefly of mineral compounds of aluminum, calcium, iron, and silicon. Some of the sulfur in coal is also in the form of minerals, especially *pyrite,* a compound of iron and sulfur. The rest is *organic sulfur,* which is closely combined with the carbon in coal. Run-of-mine coal may also contain pieces of rock or clay. These materials must be removed in addition to the other impurities.

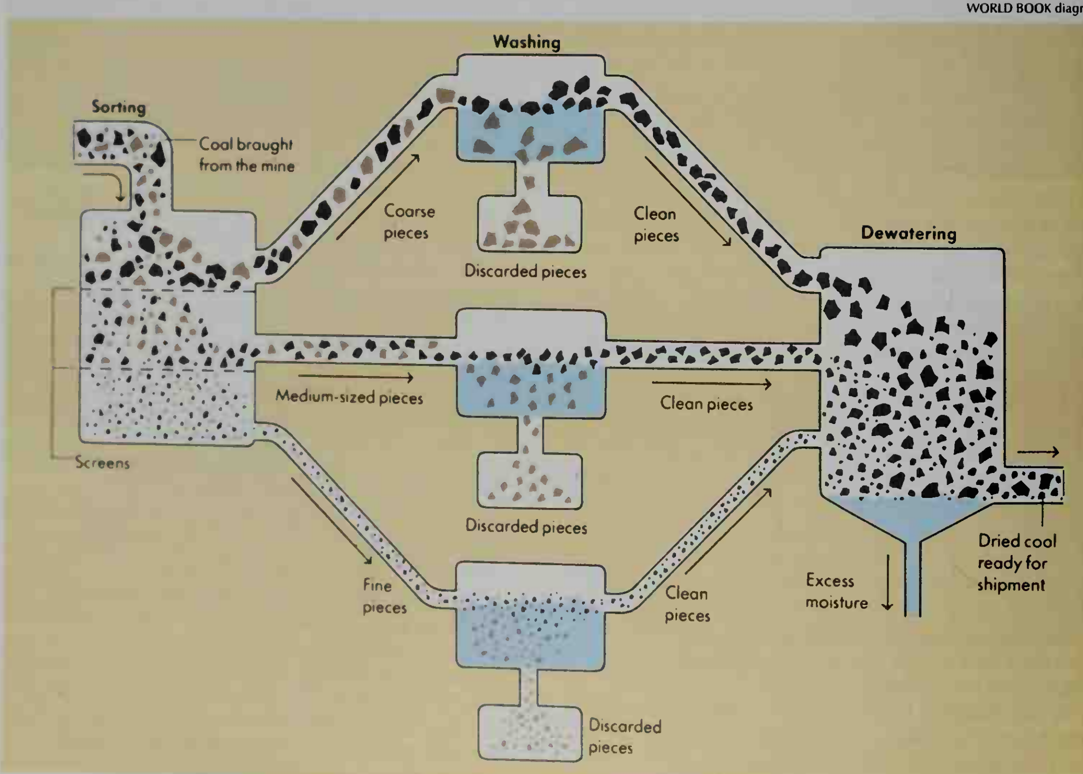
Preparation plants rely on the principle of *specific gravity* to remove impurities. According to this principle, if two solid substances are placed in a solution, the heavier substance will settle to the bottom first. Most mineral impurities in coal are heavier than pure coal. As a result, these impurities can be separated from run-of-mine coal that is placed in a solution. The entire coal-cleaning process involves three main steps: (1) sorting, (2) washing, and (3) dewatering.

Sorting. Large pieces of pure coal may settle to the bottom of a solution faster than small pieces that have many impurities. Therefore, the pieces must first be sorted according to size. In many preparation plants, a screening device sorts the coal into three sizes—coarse,

How impurities are removed from coal

Mining companies remove mineral impurities from coal by a process called *cleaning.* The process involves three main steps. (1) A screening device sorts the coal into batches of three sizes. (2) Each batch is piped into a separate washing device and mixed with water. The impurities in coal are heavier than pure coal. As a result, the first pieces of coal to settle to the bottom of each solution are those that contain the most impurities. Any loose pieces of rock or clay mixed in with the coal also sink to the bottom. All the waste pieces are discarded. (3) The clean pieces are dewatered with vibrators, spinning devices, or hot-air blowers. The coal is then ready for shipment to buyers.

WORLD BOOK diagram





Unit trains carry most large overland shipments of coal in the United States. A unit train normally carries only one kind of freight and travels nonstop from its loading point to its destination.

Dennis Brack, Black Star

medium, and fine. Large chunks are crushed and then sorted into the three main batches according to size.

Washing. The typical preparation plant uses water as the solution for separating the impurities from coal. Each batch of sorted coal is piped into a separate washing device, where it is mixed with water. The devices separate the impurities by means of specific gravity. The heaviest pieces—those containing the largest amounts of impurities—drop into a refuse bin. Washing removes much of the ash from coal. But the organic sulfur is so closely bound to the carbon that only small amounts can be removed.

Dewatering. The washing leaves the coal dripping wet. If this excess moisture is not removed, the heating value of the coal will be greatly reduced. Preparation plants use vibrators, spinning devices called *centrifuges,* and hot-air blowers to dewater coal after it is washed.

In most cases, the separate batches of coal are mixed together again either before or after dewatering. The resulting mixture of various sizes of coal is shipped chiefly to electric power companies and coking plants. All coking plants and many power companies grind coal to a powder before they use it. They therefore accept shipments of mixed sizes. Some coal users require coal of a uniform size. Preparation plants that supply these users leave the cleaned coal in separate batches.

Shipping coal. Most coal shipments within a country are carried by rail, barge, or truck. A particular shipment may travel by two or all three of these means. Huge cargo ships transport coal across oceans, between coastal ports, and on large inland waterways, such as the Great Lakes.

Barges provide the cheapest way of shipping coal within a country. But they can operate only between river or coastal ports. Trucks are the least costly means of moving small shipments of coal short distances by land. Much coal, however, must be shipped long distances over land to reach buyers. Railroads offer the most economical means of making such shipments. About two-thirds of the coal shipped from mines in the United States goes by rail.

Many large shipments of coal in the United States are delivered to electric power companies and coking plants by *unit trains.* A unit train normally carries only one kind of freight and travels nonstop from its loading point to its destination. A 100-car unit train may carry 10,000 short tons (9,100 metric tons) or more of coal. To meet the need for low-sulfur coal, more and more power plants east of the Mississippi River are importing subbituminous coal from the West. Unit trains help speed such long-distance shipments.

A 273-mile (439-kilometer) underground pipeline carries coal from a mine in Arizona to a power plant in Nevada. The coal is crushed and mixed with water to form a *slurry* (soupy substance) that can be pumped through the pipeline. The coal and power industries favor building other such pipelines in the United States.

In the past, nearly all coal shipments consisted of anthracite, bituminous coal, or subbituminous coal. It costs as much to ship a given amount of lignite as it costs to ship the same amount of a higher-ranking coal. But lignite has the lowest heating value of the four ranks. It therefore could not formerly compete with the higher-ranking coals in distant markets. Lignite was used chiefly by power plants built in the lignite fields. Conveyor belts or small railways carried the coal from the mines to the plants. But a growing need for low-sulfur coal and improvements in coal preparation technology have increased the amount of lignite shipped in the United States. Some is shipped by rail from mines in the Western United States to plants in the Midwest.

The coal industry

In most countries, the central government owns all or nearly all the coal mines. The major exceptions are Australia, Canada, Germany, South Africa, and the United States. In these countries, all or nearly all the coal mines are privately owned. In each of these countries, however, the central government regulates certain aspects of the coal industry.

Australia and the United States are the leading coal exporters in the world. The other leading exporters include Canada, China, Indonesia, Poland, and South Africa. Japan purchases approximately 30 percent of the world's coal exports—far more than any other country.

This section of the article deals chiefly with the coal industry in the United States. However, much of the information in this section also applies to the coal industry in other countries.

Coal producers. The United States has about 3,500 active coal mines and about 3,000 coal-mining companies. Most of the companies are small, independent firms that own and operate one or two small mines. All the small companies together supply less than a third of the coal mined in the United States. The 30 largest coal companies in the United States produce about two-thirds of the nation's coal. Some of the companies are independently owned, but many are owned by corporations outside the coal industry. The chief outside owners of coal-mining companies include oil companies, railroads, and ore-mining firms.

Steel companies and electric utilities in the United States also own coal mines. These companies produce coal chiefly for their own use. Their mines are known as *captive mines.*

The National Coal Association (NCA) works to promote the interests of coal producers. The NCA is jointly sponsored by the producers and the firms that supply them with equipment, technical advice, and transportation. The association tries to increase efficiency within the industry, to encourage favorable legislation, and to inform the public about the industry. The National Independent Coal Operators Association represents the smaller coal producers.



National Coal Association

Coal miners provide the labor on which the coal industry depends. These miners have just finished their day's work in an underground mine. The train will carry them to the mine exit.

Mineworkers. Most large coal-mining companies have a full-time staff of professional workers, including engineers, lawyers, and business experts. They also employ electricians, mechanics, and construction workers. Skilled miners, however, provide the labor on which the industry depends. Underground mining requires more miners than does surface mining. The United States has about 105,000 coal miners. About two-thirds of them work in underground mines.

Mechanization has helped miners become more productive. In 1950, each coal miner in the United States produced, on the average, about 7 short tons (6.4 metric tons) of coal daily. Today, the production rate averages about 32 short tons (29 metric tons) per miner per day. On the average, a strip miner produces more than twice as much coal as does an underground miner.

Increased mechanization has also made miners' jobs more specialized. The job of most miners is to operate a certain type of machine, such as a continuous miner or a power shovel. A beginning miner must work as an apprentice for a specified period to qualify for a particular job. Mine supervisors must have a license from the department of mining in their state. Generally, the licenses are granted to miners who have two to five years' experience and who pass a written examination.

Most mining engineering jobs call for a college degree in engineering. If the job is directly related to mine safety, it may also require a state engineering license called a *P.E.* (professional engineer) *certificate.* Some mining engineering jobs require a P.E. certificate only. The states grant P.E. certificates to applicants who meet certain educational requirements, have on-the-job experience, and pass a written examination. In some states, applicants must have an engineering degree. Other states require only a high school education.

Labor unions. About 45 percent of all coal miners in the United States belong to the United Mine Workers of America (UMW). The UMW was organized in 1890. At that time, the nation's coal miners lived and worked under miserable conditions. The mines were dangerously unsafe, and the miners earned barely enough to live on. Most miners and their families lived in *company towns,* which were owned and run by the mining companies. In many company towns, the housing and other facilities were far from adequate. Frequently, miners were not paid in cash. Instead, the mining companies gave them coupons that could be exchanged for goods at company-owned stores or used to pay rent on a company-owned house. The store prices and rents were unreasonably high in many cases, and some miners were always in debt to the mining companies.

During the first half of the 1900's, the UMW did much to improve the wages and working conditions of American coal miners. Through strikes and hard bargaining, the union forced the mining companies to grant the miners increasingly favorable work contracts. The UMW owed much of its success to the vigorous leadership of

John L. Lewis, who headed the union from 1919 to 1960. During Lewis' long term as UMW president, the union had the overwhelming support of its members.

Although the UMW is still important, its influence has declined. This change partly reflects a steadily improving mine safety record. Also, increased mechanization and the closing of inefficient mines has reduced the total number of jobs.

This change is also due to the rapid growth of strip mining. Strip mining requires fewer miners than does underground mining. It also requires a different type of miner. Strip miners are chiefly heavy-machine operators. Unlike underground miners, they have little need for traditional mining skills. Some strip miners are members of the UMW. But many belong to various building trades unions or to no union.

The UMW has also lost influence among its members. Many UMW members feel that their contracts with the mining companies are still far from satisfactory. The miners want better health and retirement benefits and stricter mine safety measures. During the 1970's, small groups of miners frequently took matters into their own hands and went out on *wildcat strikes,* which did not have the approval of union leaders.

Mine safety. Since 1900, more than 100,000 workers have been killed in coal mine accidents in the United States. Many more have been injured or disabled. Because of this extremely high accident rate, more and more aspects of mine safety have been brought under government regulation.

The federal government and the governments of the coal-mining states set minimum health and safety standards that the coal companies and miners have to follow. To make sure that all miners know their responsibilities, the companies must give every new miner a course in mine safety. The improvements in mine safety have greatly reduced the death and injury rates from mine accidents. In the early 1900's, about 3.5 miners per 1,000 were killed in mine accidents annually. The annual death rate has dropped to about .5 today—an improvement of about 85 percent.



Leo Touchet, The Photo Circle

Bolting the roof is an essential safety practice in an underground mine. Roof bolts are long metal rods that are inserted into the mine roof. After a bolt is fastened to the roof, *above,* it helps prevent the rock layers immediately overhead from falling.

Mine safety involves four main types of problems. They are (1) accidents involving machinery, (2) roof and rib failures, (3) accumulations of gases, and (4) concentrations of coal dust.

Accidents involving machinery kill or injure more U.S. coal miners in a typical year than any other kind of mining accident. Most strip mine accidents involve machinery. The machines in underground mines must often operate in cramped, dimly lit spaces. Thus, the miners must be doubly alert to prevent accidents.

Roof and rib failures can be prevented in many cases if a mining company carries out a scientific roof support plan. The federal government requires all U.S. mining companies to draw up such a plan for any new mine. The government must then approve the plan before mining is begun. Mining engineers make a roof support plan after studying all the rock formations surrounding the coal bed. The plan deals with such matters as the number of pillars that must be left standing, entry widths, mine geometry, and the number of roof bolts that must be used.

Accumulations of gases. Certain gases that occur in underground coal mines can become a serious hazard if they accumulate. *Methane* and *carbon monoxide* are especially dangerous. Methane is an explosive gas that occurs naturally in coal seams. It is harmless in small amounts. However, a mixture of 5 to 15 percent methane in the air can cause a violent explosion. Carbon monoxide is a poisonous gas produced by the combustion of such fuels as coal and oil. Blasting in an underground mine may produce dangerous levels of carbon monoxide if the mine is improperly ventilated.

The air vents in a mine normally prevent harmful gases from accumulating. A powerful fan at the surface circulates fresh air through the mine. The circulating air forces polluted air to the surface. As an added precaution against methane, federal law requires all underground mines to have automatic methane detectors. A mine is required to shut down temporarily if a detector shows a methane accumulation of more than 2 percent.

Concentrations of coal dust. Anyone who breathes large amounts of coal dust over a period of years may develop a disease called *pneumoconiosis* or *black lung* (see **Black lung**). The disease interferes with breathing and may eventually cause death. Thousands of coal miners have been victims of the disease. In addition, high concentrations of coal dust are explosive. A mixture of coal dust and methane is especially dangerous.

Proper ventilation removes much of the coal dust from the air in a mine. However, mines must also use other dust control measures. In the United States, federal law requires that underground mines be *rock-dusted.* In this process, the miners spray powdered limestone on all exposed surfaces in the mine entries. The limestone dilutes and coats the coal dust and so lessens the chance of an explosion. Mines use water sprays to hold down the dust along a face that is being mined.

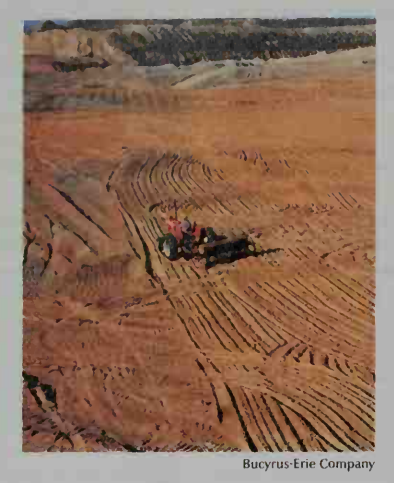
Government regulation. State departments of mining have traditionally set and enforced safety standards

How strip-mined land is reclaimed

The law requires mine owners in the United States to reclaim all the land they use for strip mining. The first step is to level the piles of dug-up soil and rock, *left.* The area may then be reseeded, *center.* The project is finally completed when the new vegetation is fully grown, *right.*



Bucyrus-Erie Company



Bucyrus-Erie Company



Bucyrus-Erie Company

for American coal mines. In the past, the U.S. Bureau of Mines had this responsibility at the federal level. On occasion, Congress has made urgently needed standards a matter of law, as in the Federal Coal Mine Health and Safety Act of 1969. This act strengthened the safety standards for mine ventilation, coal dust concentrations, roof supports, and mining equipment. The regulation of coal dust has helped reduce the occurrence of black lung among miners. In addition, the act established a federal black lung benefits program. This program provides financial and medical benefits to miners already disabled by black lung.

The Mine Safety and Health Administration enforces federal mine safety standards. This agency routinely inspects the mines for safety. The United States Department of the Interior, the United States Environmental Protection Agency (EPA), and state environmental protection agencies regulate the environmental aspects of U.S. coal-mining activities.

Coal research is sponsored by the U.S. Department of Energy, the U.S. Department of the Interior, the EPA, and several coal and oil companies. The goals of most coal research are (1) to find ways to burn more coal without increasing air pollution and (2) to develop economical methods of converting coal into liquid fuels and synthetic natural gas.

Leading coal-producing countries

Tons of coal mined in a year

Country	Tons of coal mined in a year
China	1,118,100,000 tons (1,014,330,000 metric tons)
United States	1,099,100,000 tons (997,110,000 metric tons)
India	327,980,000 tons (297,540,000 metric tons)
Australia	320,590,000 tons (290,830,000 metric tons)
Russia	276,310,000 tons (250,660,000 metric tons)
South Africa	248,130,000 tons (225,100,000 metric tons)
Germany	226,120,000 tons (205,130,000 metric tons)
Poland	190,400,000 tons (172,730,000 metric tons)
Ukraine	90,770,000 tons (82,350,000 metric tons)
Korea, North	85,450,000 tons (77,520,000 metric tons)

Figures are for 1999.
Source: U.S. Energy Information Administration.

Leading coal-producing states and provinces

Tons of coal mined in a year

State/Province	Tons of coal mined in a year
Wyoming	337,120,000 tons (305,830,000 metric tons)
West Virginia	157,980,000 tons (143,320,000 metric tons)
Kentucky	139,630,000 tons (126,670,000 metric tons)
Pennsylvania	76,400,000 tons (69,310,000 metric tons)
Texas	53,070,000 tons (48,150,000 metric tons)
Montana	41,100,000 tons (37,290,000 metric tons)
Illinois	40,420,000 tons (36,670,000 metric tons)
Alberta	37,700,000 tons (34,200,000 metric tons)
Indiana	34,000,000 tons (30,850,000 metric tons)
Virginia	32,290,000 tons (29,300,000 metric tons)

Figures are for 1999.
Sources: U.S. Energy Information Administration; Statistics Canada.

Pollution control. In 1977, Congress passed a law requiring all U.S. electric power plants built since 1971 to meet federal pollution standards by 1982. These standards, which were further tightened in the Clean Air Act of 1990, prohibit the burning of medium- or high-sulfur coals without a means of controlling sulfur dioxide pollution. Medium- and high-sulfur coals make up more than a third of all U.S. coal reserves. These resources can be used for electric power production only after ways are found to control sulfur dioxide pollution.

Cleaning removes some of the sulfur from coal. But it does not remove enough from high-sulfur and some medium-sulfur coals to meet air quality standards. Sulfur dioxide can be controlled to some extent by devices called *scrubbers.* A scrubber absorbs sulfur dioxide fumes as they pass through a plant's smokestacks.

Researchers are now working to develop new processes for using coal to produce power. These processes will make coal use more efficient and safer for the environment. They include *fluidized-bed combustion.* In this process, crushed coal is burned in a bed of limestone. The limestone captures sulfur from the coal and so prevents sulfur dioxide from forming. The heat from the burning coal boils water that is circulated through the bed in metal coils. The boiling water produces steam, which may be used to produce electricity.

Coal conversion. To turn coal into a high-energy fuel, the hydrogen content of the coal must be increased. Bituminous coals have the highest hydrogen content of the four ranks of coal. On the average, they consist of about 5 percent hydrogen. The hydrogen must be increased to about 12 percent to produce a high-energy liquid fuel and to about 25 percent to produce synthetic natural gas.

The process of converting coal into a liquid fuel is called coal *hydrogenation* or *liquefaction.* Various methods of coal hydrogenation have been developed. In the typical method, a mixture of pulverized coal and oil is treated with hydrogen gas at high temperatures and under great pressure. The hydrogen gradually combines with the carbon molecules, forming a liquid fuel. This process can produce such high-energy fuels as gasoline and fuel oil.

Coal can easily be turned into low-energy gas by the carbonization and gasification methods described in the section *The uses of coal.* Low-energy gas can also be produced from unmined coal. This process, called *underground gasification,* involves digging two widely spaced wells from ground level to the base of a coal seam. The coal at the bottom of one well is ignited. Air is blown down the second well. The air seeps through pores in the seam, and the fire moves toward it. After a passage has been burned between the two wells, the air current forces the gases up the first well. Compared with natural gas, low-energy gas made from coal has limited uses. Low-energy gas must be enriched with hydrogen for its heating value to equal that of natural gas.

The present methods of obtaining high-energy fuels from coal cost too much for commercial use. Hydrogen is expensive to produce. In addition, most fuels made from coal contain unacceptable amounts of sulfur and ash. Researchers are trying to develop cheaper methods of coal conversion. In 1980, Congress passed the Energy Security Act, which provides federal funding for coal conversion research and for the construction of synthetic fuel plants. In 1984, two commercial-sized coal gasification plants began operating in the United States. However, both plants rely heavily on the federal government for financial support.

History of coal use

No one knows where or when people discovered that coal can be burned to provide heat. The discovery may have been made independently in various parts of the world during prehistoric times. The Chinese were the first people to develop a coal industry. By the A.D. 300's, they were mining coal from surface deposits and using it to heat buildings and smelt metals. Coal had become the leading fuel in China by the 1000's.

Commercial coal mining developed more slowly in Europe. During the 1200's, a number of commercial mines were started in England and in what is now Belgium. The coal was dug from open pits and used mainly for smelting and forging metals. But most Europeans regarded coal as a dirty fuel and objected to its use.

Wood, and charcoal made from wood, were the preferred fuels in Europe until the 1600's. During the 1600's, a severe shortage of wood occurred in western Europe. Many western European countries, but especially England, then sharply increased their coal output to relieve the fuel shortage.

Developments in England. During the 1500's, English factories burned huge quantities of charcoal in making such products as bricks, glass, salt, and soap. By the early 1600's, wood had become so scarce in England that most factories had to switch to coal. By the late 1600's, England produced about 80 percent of the



Bettmann Archive

A Pennsylvania mine of the late 1800's was like coal mines everywhere before mining became mechanized and child labor was abolished. Boys and mules provided much of the labor.

Coal production in the United States since 1800*



Year	Tons	Metric tons
1800	108,000	98,000
1810	178,000	161,000
1820	334,000	303,000
1830	881,000	799,000
1840	2,474,000	2,244,000
1850	8,356,000	7,580,000
1860	20,041,000	18,181,000
1870	40,429,000	36,677,000
1880	79,407,000	72,037,000
1890	157,771,000	143,127,000
1900	269,684,000	244,653,000
1910	501,596,000	455,040,000
1920	658,265,000	597,168,000
1930	536,911,000	487,077,000
1940	512,256,000	464,711,000
1950	560,388,000	508,375,000
1960	434,330,000	394,018,000
1970	612,659,000	555,795,000
1980	829,700,000	752,691,000
1985	883,638,000	801,623,000
1990	1,029,076,000	933,562,000
1995	1,032,974,000	937,098,000
1999	1,099,120,000	997,105,000

*Includes all types of coal—anthracite, bituminous and subbituminous coals, and lignite.
Source: U.S. Energy Information Administration.

world's total coal output. It remained the leading coal producer for the next 200 years.

Charcoal had also been widely used in England as a fuel for drying malt, the chief ingredient in beer. Brewers tried using coal for this process. But the gases it produced were absorbed by the malt and so spoiled the flavor of the beer. The brewers found, however, that the undesirable gases could be eliminated if they preheated the coal in an airtight oven. They thus developed the process for making coke. About 1710, an English ironmaker named Abraham Darby succeeded in using coke to smelt iron. Coke then gradually replaced charcoal as the preferred fuel for ironmaking.

The spread of the new ironmaking process became part of a much larger development in England—the Industrial Revolution. The revolution consisted chiefly of a huge increase in factory production. The increase was made possible by the development of the steam engine in England during the 1700's. Steam engines provided the power to run factory machinery. But they required a plentiful supply of energy. Coal was the only fuel available to meet this need.

During the 1800's, the Industrial Revolution spread from England to other parts of the world. It succeeded chiefly in countries that had an abundance of coal. Coal thus played a key role in the growth of industry in Europe and North America.

Developments in North America. The North American Indians used coal long before the first white settlers arrived. For example, the Pueblo Indians in what is now the southwestern United States dug coal from hillsides and used it for baking pottery. European explorers and settlers discovered coal in eastern North America during the last half of the 1600's. In the 1700's, a few small coal mines were opened in what are now Nova Scotia, Virginia, and Pennsylvania. The mines supplied coal chiefly to blacksmiths and ironmakers. Most settlers saw no advantage in using coal as long as wood was plentiful. Wood and charcoal remained the chief fuels in America throughout the 1700's.

The Industrial Revolution spread to the United States during the first half of the 1800's. By then, coal was essential not only to manufacturing but also to transportation. Steamships and steam-powered railroads were becoming the chief means of transportation, and they required huge amounts of coal to fire their boilers. As industry and transportation grew in the United States, so did the production and use of coal. By the late 1800's, the United States had replaced England as the world's leading coal producer.

The United States led in coal production until the mid-1900's. Its demand for coal then declined as the use of petroleum and natural gas increased. The Soviet Union surpassed the United States in coal production from the late 1950's through the late 1970's. During the 1980's and 1990's, China usually ranked first, and the United States usually ranked second.

Recent developments. The growing scarcity of petroleum and natural gas has led to a sharp rise in the demand for coal. As a result, coal production in the United States increased greatly in the 1970's, 1980's, and 1990's. The increased output was used mainly to produce electric power. Today, electric power can be produced more cheaply from coal than from either natural gas or fuel oil. Joseph W. Leonard III

Critically reviewed by the National Coal Association

Related articles in *World Book* include:

Basic coal products

Ammonia
Coal tar
Coke
Coke oven gas
Gas (fuel)

Other related articles

Black lung
Child labor
Damp
Diamond
Energy supply
Hanna, Mark
Heating (Coal)
Hydrogenation
Industrial Revolution
Iron and steel
Jet
Lewis, John L.
Mining
Peat
Safety lamp
United Mine Workers of America
West Virginia (pictures)

Outline

I. **How coal was formed**
II. **Where coal is found**
  A. World coal reserves
  B. Location of U.S. and Canadian reserves
III. **The uses of coal**
  A. Coal as a fuel
  B. Coal as a raw material
IV. **How coal is mined**
  A. Surface mining
  B. Underground mining
V. **Cleaning and shipping coal**
  A. Cleaning coal
  B. Shipping coal
VI. **The coal industry**
  A. Coal producers
  B. Mineworkers
  C. Labor unions
  D. Mine safety
  E. Government regulation
  F. Coal research
VII. **History of coal use**

Questions

How was coal formed?
What is by far the chief system of underground coal mining in the United States?
What is the main use of coal?
Why are coal miners more productive today than they were in the past?
How is coal usually classified? What are the four main classes of coal?
What are *preparation plants*? Why are they needed?
Why did many countries in western Europe sharply increase their coal output during the 1600's?
What is *strip mining*? What environmental problems can it cause? How can these problems be prevented?
Why has coal mining become a less dangerous occupation than it was in the past?
Why have more and more power plants switched from bituminous coal to subbituminous coal or lignite?

Additional resources

Level I
Bartoletti, Susan C. *Growing Up in Coal Country.* Houghton, 1996.
Dineen, Jacqueline. *Coal.* Enslow, 1988.
Hansen, Michael C. *Coal: How It Is Found and Used.* Enslow, 1990.

Level II
Dublin, Thomas. *When the Mines Closed.* Cornell Univ. Pr., 1998.
Lockard, Duane. *Coal: A Memoir and Critique.* Univ. Pr. of Va., 1998.
Williams, A., and others. *Combustion and Gasification of Coal.* Taylor & Francis, 1999.

Coal gas. See Coke oven gas.
Coal oil. See Kerosene.
Coal tar is a thick, black, sticky liquid obtained as a by-product in the manufacture of coke and coke oven gas from soft coal. Various grades of tar are recovered by *condensing* (changing to liquid) hot vapors from a coke oven or a coal gas producer. Manufacturers heat coal tar and condense its vapors to produce light oils, such as *benzene* and *toluene.* Benzene is used as a solvent and in the production of perfumes and some gasolines, and toluene is used in the manufacture of dyes, paints, explosives, and antiseptics.

Tar acids, such as *carbolic acid,* and tar bases, such as *aniline,* are other coal tar products. Carbolic acid and aniline are used to make dyes. *Creosote* and *pitch* are heavy liquid coal tar products. Creosote preserves wood, and pitch is used in the manufacture of roofing materials and paint. Sir William H. Perkin, an English chemist, pioneered in coal tar chemistry by making mauve, the first synthetic dye. *Petrochemicals* (chemicals made from petroleum) are increasingly supplementing coal tar chemicals for use in industry and chemistry.

Joseph W. Leonard III

Related articles in *World Book* include:

Aniline
Benzene
Coal (Coal as a raw material)
Coke
Coke oven gas
Creosote
Distillation (Destructive distillation)
Dye
Naphtha
Perfume
Pitch
Tar
Toluene

Coalescence theory. See **Rain** (Formation of rain; diagram: The coalescence process).
Coalition, *KOH uh LIHSH uhn,* is a combination of political interest groups working toward a mutual goal. Coalitions often form in countries with parliamentary forms of government because these systems have a number of political parties. A single party may be unable to win a majority in the parliament, causing various parties to form coalitions that have a majority of seats.

In the United States, various conditions encourage interest groups to form coalitions to pressure legislators and executives. These conditions include the separation of powers among branches of the federal government and frequent disagreements among members of the same political party. In the U.S. Congress, for example, conservative Democrats and Republicans have formed a powerful coalition that often shapes legislation. Coalitions between Democrats and Republicans exist at all levels of government. Peter Woll

See also **Political party** (Multiparty systems).
Coanda, *kaw ahn DA,* **Henri-Marie,** *ahn REE ma REE* (1885-1972), was a Romanian aviation pioneer, engineer, and inventor. He is best known for developing a disk-shaped craft based on what is now called the *Coanda effect,* the tendency of a fluid passing a curved surface to attach itself to the surface. This principle is used in a sensing and control technology called *fluidics.* Coanda also invented an airplane based on a jet-propulsion system and a device that uses the energy of the sun to convert salt water to fresh water. Coanda was born in Bucharest, Romania. Tom D. Crouch

U.S. Coast Guard

The United States Coast Guard patrols the oceans in such vessels as the high-endurance cutter *Mellon, shown here.* The Coast Guard also protects United States ports and ships and enforces maritime laws. Coast Guard craft bear the official insignia shown at the right.



United States Coast Guard

Coast Guard, United States, is a branch of the armed services. The Coast Guard works to protect the public, the environment, U.S. economic interests, and national security in maritime regions. The regions where the Coast Guard operates include U.S. coasts, ports, and inland waters, and international waters. Its many duties give special meaning to its motto, *Semper Paratus,* which means *always ready.*

The Coast Guard is the nation's oldest continuous seagoing force. Since 1790, it has grown from a fleet of 10 small sailing vessels to a force of modern ships and aircraft. Its members have fought in every major war of the United States. They have rescued hundreds of thousands of people from disasters and have saved billions of dollars worth of property from shipwrecks and floods.

The Coast Guard maintains an active-duty force of about 35,000 men and women. It has 14,000 reserve members; a 34,000-member, all-volunteer Coast Guard Auxiliary; and a civilian work force of more than 5,000.

The Coast Guard emblem was adopted in 1927. "Semper Paratus" is the Coast Guard's famous marching song.

Coast Guard activities

The Coast Guard enforces all federal laws and treaties on the high seas and on the navigable waters of the United States. These include criminal laws, inspection laws, pollution laws, revenue and navigation laws, and nautical rules of the road. Coast Guard activities are directed toward five main purposes: (1) safety, (2) national defense, (3) maritime security, (4) mobility, and (5) protection of the environment.

Safety. The Coast Guard works worldwide to limit deaths, injuries, and property damage associated with maritime transportation, fishing, and recreational boating. It enforces and helps establish safety regulations governing the construction and operation of merchant ships and passenger ships. It establishes safety rules for passengers, and tests and licenses crew members. In addition, the Coast Guard establishes safety standards for yachts, motorboats, and other noncommercial vessels.

Coast Guard ships, which are called *cutters,* patrol oceans and inland waterways. The Coast Guard operates search-and-rescue stations along the coasts of the United States and its territories, and in the Great Lakes. When accidents occur, rescue boats and aircraft go into action immediately. They rescue people who have been involved in boating accidents, shipwrecks, airplane crashes, and hurricanes. They also tow damaged vessels to shore. The Coast Guard helps rescue any person or ship, regardless of nationality. It provides emergency medical aid to crews of all vessels at sea and takes injured or critically ill crew members to shore bases for treatment.

Ships at sea depend on Coast Guard aids to naviga-

ion. Such guides as beacons, buoys, fog signals, ighthouses, and radio stations reduce the dangers of navigation. The Coast Guard uses Loran stations and the Global Positioning System to help ships determine their exact positions at sea (see **Loran; Global Positioning System**). Coast Guard units report weather information to the U.S. National Weather Service, which uses the data for forecasting. The International Ice Patrol, operated by the Coast Guard, locates and tracks icebergs in shipping lanes in the North Atlantic and warns ships about them.

The Coast Guard Auxiliary, a voluntary association of yacht and motorboat sailors and owners and aircraft owners, also promotes safety. It checks boats for safety equipment, helps with rescues, and conducts classes on boating safety.

National defense. The Coast Guard defends the United States as one of the five armed services. In both peacetime and wartime, the Coast Guard and the United States Navy work together. The Coast Guard participates in military exercises with the Navy and with forces of countries that are members of the North Atlantic Treaty Organization (NATO). In wartime, the Coast Guard serves as part of the Navy. It provides escorts for merchant ships, helps guard ports and shipping lanes for the United States and its allies, and provides air-sea rescue services.

Maritime security. The Coast Guard helps other federal agencies enforce their laws concerning customs, immigration, and quarantines. Patrols along U.S. coasts serve to prevent the transport of illegal drugs, immigrants, and contraband into the United States through sea routes. The Navy aids the Coast Guard in preventing the smuggling of illegal drugs. The Coast Guard also prevents illegal fishing. Its port security program helps keep waterfronts safe by controlling traffic and regulating shipment of dangerous cargoes.

Mobility. The Coast Guard works to ease maritime commerce by eliminating interruptions and obstacles to the efficient and economical movement of goods and people. Special Coast Guard cutters called *icebreakers* clear icebound harbors on the North Atlantic coast, on the Great Lakes, and on inland rivers. The Coast Guard works to provide the greatest possible access to water for recreation.

Protection of the environment. The Coast Guard works to eliminate damage to natural resources and the environment associated with maritime transportation, fishing, and recreational boating. Its work in preventing illegal fishing helps to preserve valuable fish stocks. The

Work of the Coast Guard



U.S. Coast Guard

A motor lifeboat battles rough water during a rescue.



U.S. Coast Guard

A transportable port security boat races into action.



U.S. Coast Guard

An icebreaker clears ice from a shipping lane.



U.S Coast Guard

Coast Guard patrols enforce fishing regulations that help maintain fish populations. This coastguardsman is inspecting a fish to ensure that it is large enough to be legally taken from the sea.

port security program monitors pollution on waterfronts. Coast Guard icebreakers support research scientists in the Arctic and Antarctic.

Life in the Coast Guard

Careers in the Coast Guard include a variety of challenging positions. A member of the Coast Guard can become an expert in a specialized field. Coast Guard training also prepares members for civilian jobs when their enlistments end or they retire from service.

Applicants must be at least 17 years of age and not older than 27. They must meet Coast Guard physical standards and pass the Armed Forces Qualifications Test. They may have no more than two dependents.

Many Coast Guard officers receive their training at the U.S. Coast Guard Academy in New London, Connecticut. Applicants to the Coast Guard Academy must be high school graduates who have not yet turned 22 years old. They must be unmarried, meet rigid physical standards, and be of good moral character. Cadets are appointed on the basis of a nationwide competition each year. Applications to enter the competition should be sent to the Director of Admissions, U.S. Coast Guard Academy, New London, CT 06320.

Men and women between the ages of 17 and 26 with a bachelor's degree from an accredited college or university may apply to Coast Guard officer-candidate school. This 17-week program is conducted at the Coast Guard Academy. Enlisted men and women who qualify may also apply. Graduates receive commissions as ensigns and serve at least three years of active duty. A four-week direct commission program enables licensed merchant marine officers, graduates of maritime academies, former military pilots, engineers, and lawyers to become Coast Guard officers.

Officers and enlisted men and women in the Coast Guard hold the same ranks and earn the same pay as those in the Navy. Enlisted men wear the same blue uniforms as male Coast Guard officers, and enlisted women wear the same blue dress uniforms as female officers. The only differences in the uniforms is in the rank insignia. See **Rank, Military.**

Training a recruit begins at "boot camp" at Cape May, New Jersey. Recruits receive eight weeks of basic training. They take courses in communications, firefighting, first aid, gunnery, military drill, physical education, and seamanship. Specially trained petty officers teach the courses. The Coast Guard tries to place men and women in positions for which they are best suited. It encourages them to specialize in a selected field.

Training an officer. A cadet at the Coast Guard Academy takes a four-year course and graduates with a Bachelor of Science degree and a commission as an ensign in the Coast Guard. Members of each new class enter the academy during the summer, usually in late June or early July. These cadets are called *swabs.* They spend their *swab summer* becoming adjusted to military life. Coast Guard cadets spend part of each summer at sea, training aboard the bark *Eagle* or on major cutters. See **United States Coast Guard Academy.**

Ships, aircraft, and weapons of the Coast Guard

Ships and stations. The Coast Guard maintains a fleet of several hundred ships and boats that can perform various assignments. These vessels include buoy tenders, cutters, icebreakers, lifeboats, surfboats, and tugboats. The service operates about 70 offices devoted to marine safety, port security, and shipping-inspection duties. The Coast Guard also maintains light towers, navigational aids, and about 190 law enforcement and search-and-rescue stations.

Aircraft play a major part in Coast Guard operations. The Coast Guard uses cargo planes, jets, and helicopters for patrol, law enforcement, and search-and-rescue missions. Helicopters are particularly important to the Coast Guard in air-sea rescues, in bringing help to flood victims, and in rescuing disaster victims in inland areas that could not otherwise be reached. During World War II (1939-1945), Coast Guard aircraft bombed enemy submarines. Aircraft of the Coast Guard also rescued many survivors of torpedoed ships.

Weapons. All Coast Guard vessels are armed with at least small arms. Weapons used by the Coast Guard range from 9-millimeter pistols, M-16 rifles, and machine guns on small patrol vessels to 76-millimeter cannons on large cutters. The crews of larger Coast Guard vessels periodically train with the Navy.

Organization of the Coast Guard

Coast Guard headquarters are in Washington, D.C. The commandant of the Coast Guard—an admiral—heads the service, assisted by a vice commandant, a planning and control staff, and various Coast Guard departments. The United States and its possessions are divided into nine Coast Guard districts. Each district is headed by a district commander.

Active-duty and reserves. The *active-duty Coast Guard* makes up the core of the service. It consists of officers and enlisted men and women who have chosen the Coast Guard as a full-time career. The Coast Guard

Reserve is a group whose members may be called to active duty in time of emergency. Their training is similar to that of the regulars and includes port security and other wartime missions.

Women in the Coast Guard can serve in any occupational specialty. Women first entered the Coast Guard in 1942 as a reserve group called the SPARS. The name SPAR comes from the first letters of the Coast Guard motto, *S*emper *P*aratus, and its English translation, *A*lways *R*eady. The SPARS filled administrative jobs to free Coast Guard men for sea duty during World War II. When the war ended in 1945, the SPARS had 10,000 enlisted women and 1,000 officers. All of them were discharged or placed on inactive duty by June 1946, and the group was dissolved. In November 1949, shortly before the Korean War, the SPARS was reactivated. It was disbanded again in 1974, when women became a part of the regular Coast Guard.

History

The Coast Guard began its history as the Revenue Cutter Service. This service was created in 1790 at the recommendation of Alexander Hamilton, the first secretary of the treasury. Congress established this fleet of 10 small sailing vessels to stamp out smuggling and piracy along the coasts of the United States. Revenue Cutter Service officers had permission to board all vessels that entered United States waters and to examine their cargoes. From 1790 until 1798—when the Navy was reorganized—the Revenue Cutter Service served as the nation's only naval force. The service saw its first wartime activity from 1798 to 1800, when it cooperated with the Navy in fighting French privateers. The service also fought during the War of 1812.

New duties. For many years, private organizations, such as the Massachusetts Humane Society, operated the only lifesaving services on the Atlantic Coast. In 1831, the Revenue Cutter Service began its first winter cruising to aid seafarers and ships in distress. This activity may have lasted only one season, however. In 1837, Congress authorized the use of public vessels to cruise the coast in rough weather and help mariners in distress. In 1848, Congress funded the construction of lifesaving stations to be staffed by volunteers. In 1871, the government took over the stations and formed the U.S. Life-Saving Service, which was operated by the Revenue Cutter Service. In 1878, the Life-Saving Service became an independent bureau of the Department of the Treasury. The Revenue Cutter and Life-Saving services were combined as the United States Coast Guard in 1915. The Federal Lighthouse Service became a part of the Coast Guard in 1939. The Bureau of Marine Inspection and Navigation was transferred from the Department of Commerce to the Coast Guard in 1942.

World War I. On April 6, 1917, after the United States declared war on Germany, the Coast Guard's more than 200 officers and 5,000 enlisted men were ordered into action with the Navy. The Coast Guard served in the thick of the action, escorting cargo ships and screening transports from the enemy.

U.S. Coast Guard



The *Eagle,* a sailing ship, is used by the United States Coast Guard Academy to train cadets. The men and women of the Coast Guard also receive training on modern motorized ships.

A great sea tragedy occurred on Sept. 26, 1918. The cutter *Tampa,* having escorted a group of cargo ships from Gibraltar to England, was returning to a port in Wales when it disappeared with a loud explosion. The entire crew of 111 Coast Guard and 4 Navy men was lost. Authorities believe that a German *U-boat* (submarine) torpedoed the cutter.

World War II saw the United States Coast Guard serving as a specialized branch of the Navy. The service was responsible for handling and stowing explosives and other dangerous cargo, and for protecting vessels and port facilities from fire, negligence, or damage. The Coast Guard also furnished weather reports, provided cutters for *convoy* (escort) duty, and staffed many Army and Navy vessels. It took part in every Pacific and European landing operation.

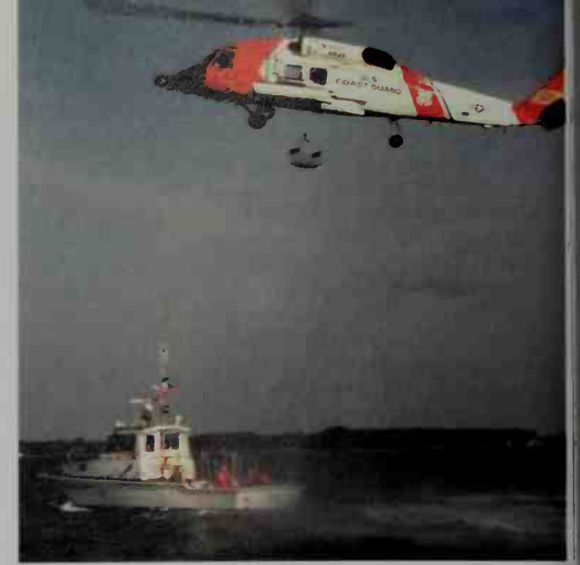
The Coast Guard Auxiliary was formed in 1939. During World War II, its members offered their boats and their services to the Coast Guard without pay. They wore uniforms and served under military discipline while on active duty. The Coast Guard Reserve was established in 1941. During the war, about 7,100 reserve officers and about 135,000 enlisted men were on active duty in the Coast Guard.

The Coast Guard since World War II. In 1957, three cutters, *Storis, Bramble,* and *Spar,* were the first U.S. ships to sail through the Northwest Passage, the deep-water passage across the top of North America. In 1967, the Coast Guard was transferred from the United States Treasury Department to the newly created Department of Transportation.

From 1965 to 1972, during the Vietnam War, Coast Guard squadrons patrolled the coastal waters of South Vietnam. The 56 cutters were assigned to prevent the flow of Communist troops and equipment from North Vietnam to South Vietnam.

In 1972, Congress passed the Ports and Waterways Safety Act. This legislation directed the Coast Guard to establish regulations governing the construction of oil tankers and other ships that would carry polluting substances in United States waters. The legislation also authorized the Coast Guard to develop vessel traffic control systems to help prevent accidents in crowded harbors and waterways.

In 1989, the Coast Guard headed the cleanup of nearly



U.S. Coast Guard

Helicopters are often used in rescue operations. This HH-60 Coast Guard helicopter is preparing to hoist a person from a Coast Guard utility boat.



U.S. Coast Guard

Navigational buoys serve as guides to vessels along coasts. Members of the Coast Guard serving aboard ships called *buoy tenders* inspect and repair these buoys regularly.

Important dates in Coast Guard history

1790 The U.S. Congress authorized the construction of 10 cutters for a Revenue Cutter Service.

1819 Congress authorized revenue cutters to protect United States merchant vessels against piracy.

1861 The cutter *Harriet Lane* fired the first shot from any vessel in the Civil War.

1898 The cutter *McCulloch* sent the first news of the victory over the Spanish fleet at Manila Bay.

1915 The Revenue Cutter Service and the Life-Saving Service combined to form the U.S. Coast Guard.

1917 During World War I, the Coast Guard served as part of the Navy.

1939 The Lighthouse Service of the Department of Commerce was transferred to the Coast Guard.

1945 The icebreaker *Mackinaw* made the first winter trip through the Soo locks on Lake Superior.

1957 The cutters *Storis, Bramble,* and *Spar* became the first U.S. ships to sail through the Northwest Passage.

1967 The Coast Guard was transferred from the Treasury Department to the Department of Transportation.

1976 The Coast Guard Academy admitted women students for the first time.

1979 Two Coast Guard women officers became the first women to command U.S. warships.

1989 The Coast Guard supervised the cleanup of a huge oil spill off the coast of Alaska after the tanker *Exxon Valdez* ran aground in Prince William Sound.



U.S. Coast Guard

Coast Guard airplanes, such as this long-range aircraft, are used for search and rescue missions at sea. The planes also patrol United States waters and enforce maritime laws.



U.S. Coast Guard

The cleanup of oil and chemical spills in U.S. waters is supervised and coordinated by the Coast Guard. This coastguardsman is checking for damage after an oil spill in Maryland.

11 million gallons (42 million liters) of crude oil that spilled into Prince William Sound in southeastern Alaska. The oil spill—the largest in North American history—occurred after the U.S. tanker *Exxon Valdez* struck a reef in the sound. In 1991, the Coast Guard served in the Persian Gulf War. From 1992 to 1994, it stopped nearly 100,000 migrants fleeing Cuba and Haiti from entering the United States illegally.

In 2002, President George W. Bush proposed the creation of a new Department of Homeland Security, an executive department of the federal government that would emphasize protection against terrorism. Under Bush's plan, the Coast Guard would be moved to the new department from the Department of Transportation.

Critically reviewed by the United States Coast Guard

Related articles in *World Book* include:

Beacon
Boating (Boating regulations)
Buoy
Flag (picture: Flags of the armed forces)
Flood
Icebreaker
Lighthouse
Loran
Navy, United States
United States Coast Guard Academy

Outline

I. Coast Guard activities
A. Safety
B. National defense
C. Maritime security
D. Mobility
E. Protection of the environment

II. Life in the Coast Guard
A. Careers in the Coast Guard
B. Training a recruit
C. Training an officer

III. Ships, aircraft, and weapons of the Coast Guard
A. Ships and stations
B. Aircraft
C. Weapons

IV. Organization of the Coast Guard
A. Coast Guard headquarters
B. Active-duty and reserves
C. Women in the Coast Guard

V. History

Questions

What is the motto of the Coast Guard? What does it mean?
What are the Coast Guard's law-enforcement duties?
How is the Coast Guard related to the U.S. Navy?
What is the *active-duty Coast Guard*?
How does the Coast Guard aid navigators?
What is the International Ice Patrol?
How are aircraft important to the Coast Guard?
What was the role of the Coast Guard during World War II?
Why was the Coast Guard's forerunner, the Revenue Cutter Service, established?

Coast Guard Academy, United States. See United States Coast Guard Academy.

Coast Ranges are a system of mountain ranges that forms North America's western coast for about 2,500 miles (4,020 kilometers). The ranges extend from Kodiak Island, Alaska, to southern California. Ten separate mountain ranges make up the Coast Ranges region. The Kodiak, Kenai, Chugach, and St. Elias ranges, and the Alexander Archipelago, a group of islands formed by the tops of sunken mountains, are in Alaska. The Queen Charlotte Islands and the Vancouver Range are in British Columbia. The Oregon Coast Range extends from southern Washington to central Oregon. The California Coast Range is in central California, and the Los Angeles Ranges rise along the coast of southern California. The Coast Ranges are interrupted by the Olympic Mountains in northwestern Washington and by the Klamath Mountains in southern Oregon. The northern coast is sunk in great bays and straits from Shelikof Strait to Puget Sound. The southern coastline is high and regular, broken only by a few harbors. See also United States (The Pacific Ranges and Lowlands). Jois C. Child

Coastal plain. See Plain.

Coat of arms. See Heraldry.

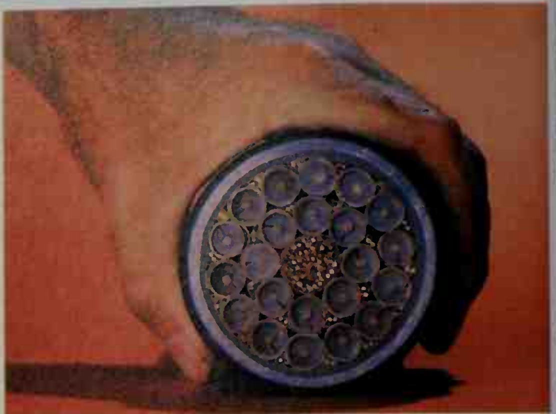
Coati, *koh AH tee,* also called *coatimundi, koh AH tee MUHN dee,* is a member of the raccoon family. It has a long, flexible snout and often carries its long, ringed tail straight up. Coatis live in wooded areas from Arizona southward to northern Argentina. They measure from 16 to 26 inches (41 to 66 centimeters) long, not counting the tail, and weigh from 10 to 15 pounds (4.5 to 6.8 kilograms). Coatis of the dry hills of Arizona have sandy-blond fur. Chocolate-brown coatis live in the rain forest of Panama. South American coatis are reddish-brown.

Coatis eat almost anything they can easily find, including insects, land crabs, snails, spiders, and a variety of



Warren Garst, Tom Stack & Assoc.

The coati is related to the raccoon. It has a long flexible snout and a long ringed tail. The animal uses its claws to dig in the ground, and it will eat almost any food it can easily find.



Bell Laboratories

A typical coaxial cable contains 22 tube-enclosed communications wires and many other wires for maintenance and control. The cable is about 3 inches (8 centimeters) in diameter.

fruits. They also eat birds' eggs, lizards, and mice.

Coatis move about mostly in the daytime and are at home both on the ground and in trees. They are curious, intelligent animals and continually sniff the air and dig into the ground with their claws as they wander through the woods. Females and young coatis travel in bands of 6 to 20 animals, but adult males live alone. The word *coatimundi* is an Indian term meaning "lone coati," and it actually refers only to the males.

Each year, a male joins each band for the mating season, which lasts about a month. About 10 or 11 weeks after mating, the pregnant females leave the group. They build tree nests of sticks and leaves and give birth to three or four young. About six weeks later, the mothers and their young rejoin the bands. See also **Animal** (picture: Animals of the tropical forests). Hugh H. Genoways

Scientific classification. Coatis form the genera *Nasua* and *Nasuella* in the raccoon family, Procyonidae. One species is *Nasua narica.*

Coatsworth, Elizabeth (1893-1986), was an American author best known for her children's books. Much of her work deals with rural New England, but she also wrote fantasies and stories with settings in early American history and the Far East. She won the 1931 Newbery Medal for *The Cat Who Went to Heaven* (1930), which resembles a Japanese Buddhist folk tale.

Coatsworth's other children's books include *Away Goes Sally* (1934), *Here I Stay* (1938), *First Adventure* (1950), *Silky* (1953), *The White Room* (1958), *The Hand of Apollo* (1965), *Grandmother Cat and the Hermit* (1970), and *Under the Green Willow* (1971). She also wrote novels, poetry, and stories for adults. Coatsworth was born on May 31, 1893, in Buffalo, New York. She died on Aug. 31, 1986. Virginia L. Wolf

Coaxial cable is a type of cable that contains two conductors—an inner one and an outer one. It is called *coaxial* because both conductors have the same *axis* (center). The outer conductor is shaped like a tube. It may be made of a flexible woven metal braid or solid metal. The inner conductor is a wire that runs through the center. The conductors are separated by insulation, usually a plastic. A layer of plastic typically coats the outer conductor, insulating the cable from outside contact and protecting it from damage. Cables with outer conductors of solid metal may be uncoated. Coaxial cables range in diameter from about $\frac{1}{10}$ inch (4 millimeters) to more than 3 inches (8 centimeters). Several small cables may be bundled together inside one large one.

Uses. Fiber-optic cables have replaced coaxial cables for some communications applications (see **Fiber optics**). But coaxial cables are still used to transmit electric power and to send communications signals to and from antennas. A coaxial cable can carry high-frequency communications signals more efficiently than other types of cables. A large-diameter coaxial cable can carry thousands of telephone conversations or hundreds of cable television signals at once. Smaller cables transfer signals to and from the antennas of communications equipment used by the military, police and fire departments, and other government and private agencies. Still smaller cables transfer signals between electronic devices used in the home and in offices.

History. The invention of modern coaxial cable is generally credited to two American electrical engineers, Lloyd Espenschied and Herman A. Affel. Both men worked for the American Telephone and Telegraph Company (AT&T). When they patented their work in 1931, the cable was intended to be used for transmitting television signals. However, the cable was first used to transmit voice signals between New York City and Philadelphia in 1936. Thomas J. Parker

See also **Cable**.

Cobalt is a silver-white metallic element that has properties similar to those of iron and nickel. All three metals are hard and magnetic. Cobalt is used chiefly in *alloys* (mixtures of metals).

Cobalt's *atomic number* (number of protons) is 27. Its *relative atomic mass*—that is, its *mass* (amount of matter) compared to that of carbon 12, the most common form of carbon—is 58.93320 unified atomic mass units (u). By agreement, 1 u is $\frac{1}{12}$ the mass of one atom of carbon 12. Cobalt has a density of 8.9 grams per cubic centimeter. It melts at a temperature of 1495 °C and boils at 2870 °C. Its chemical symbol is Co. The Swedish chemist Georg Brandt first isolated cobalt in the 1730's.

Sources. Cobalt makes up only about 30 millionths of

the mass of Earth's crust. It occurs in cobalt ores in chemical compounds with arsenic, oxygen, or sulfur. Those cobalt compounds also occur in nickel, iron, and copper ores. Congo (Kinshasa) and Zambia have more than half the world's reserves of cobalt ores. Other major deposits lie in Australia, Azerbaijan, Canada, Cuba, Finland, Kazakhstan, and New Caledonia.

Uses. Cobalt is combined with carbon and tungsten or with chromium, iron, and other metals to create exceptionally hard alloys for drill bits and cutting tools. Cobalt alloys that withstand high temperatures are used in gas turbines and jet engines. Alloys are also used in dental and surgical applications for their stability.

Cobalt alloys with aluminum, nickel, iron, or other metals are used in very strong *permanent magnets*—that is, magnets that do not lose their magnetization. Cobalt magnets are used in magnetic resonance imaging (MRI) machines, electronic devices, and speakers.

Cobalt oxides (compounds that include cobalt and oxygen) have been used since ancient times to add deep blue color to pottery, glass, and enamels. They are also used in artists' blue paints, inks, and dyes. The paint industry uses cobalt *salts* to speed drying of paints, lacquers, and varnishes. A salt is a compound that results when a base neutralizes an acid (see **Salt, Chemical**). Other uses of cobalt salts are electroplating and the bonding of rubber to steel in tires.

Cobalt *catalysts* aid in the production of liquid fuels and organic compounds from petroleum. Catalysts are substances that increase the speed of a chemical reaction without being consumed by the reaction. Vitamin B_{12} contains cobalt. Vitamin B_{12} is needed for nerve cells to function properly, and it helps red blood cells form.

Physicians use cobalt 60, a radioactive *isotope* (form) of cobalt, to treat cancer patients. Some food-processing plants use radiation from cobalt 60 to kill bacteria in foods. Irradiation also kills insects in foods and stops the sprouting of some vegetables. Emily Jane Rose

Cobb, Ty (1886-1961), was one of the greatest and most exciting players in baseball history. He ranks as the all-time leading hitter in the major leagues with a .367 lifetime batting average. His career total of 2,245 runs scored stood as a major league record until Rickey Henderson broke it in 2001. Cobb's career total of 4,191 hits also was a major league record until Pete Rose broke it in 1985. Cobb won 12 American League batting titles, including 9 in a row from 1907 to 1915. He also stole 892 bases during his 24-year career.

Tyrus Raymond Cobb was born on Dec. 18, 1886, in Banks County, Georgia, near Homer. He was nicknamed "The Georgia Peach." Cobb, an outfielder, began his major league career with the Detroit Tigers in 1905 and played with the team until 1926. He also managed the Tigers from 1921 to 1926. He spent 1927 and 1928, the final years of his career, playing for the Philadelphia Athletics. Cobb was a fierce competitor who was unpopular with opponents because of his frequent rough play. In 1936, he became one of the first five players elected to the National Baseball Hall of Fame. Cobb died on July 17, 1961. Dave Nightingale

Additional resources

Alexander, Charles C. *Ty Cobb.* 1984. Reprint. Oxford, 1985.
Stump, Al. *Cobb.* 1994. Reprint. Algonquin Bks., 1996.

Cobden, Richard (1804-1865), was a British manufacturer and statesman who vigorously urged free trade. He believed that eliminating tariffs and other restrictions on trade would improve relations between nations and lead to world peace.

Cobden was born on June 3, 1804, in England near Midhurst, Sussex. He became a partner in a textile business in 1828. Cobden helped organize the Anti-Corn Law League in 1838. The United Kingdom's corn laws were designed to keep the price of small grains high (see **Corn laws**). He was elected to Parliament in 1841 and helped repeal the corn laws in 1846. Cobden opposed the United Kingdom's part in the Crimean War (1853-1856), and this stand contributed to his defeat in 1857. Cobden was reelected in 1859. He died on April 2, 1865. Vernon F. Snow

See also **Peel, Sir Robert** (Prime minister).

Cobra, *KOH bruh,* is any of a group of poisonous "hooded" snakes. When excited, cobras flatten the neck by moving the ribs. This movement gives the appearance of a hood. In most snakes, the neck ribs are shorter than those farther back. But in cobras with large hoods, the neck ribs are the longest. These ribs are almost straight instead of curved like those of the body.

Cobras use their deadly poison in two ways. Some types bite their victims with poisonous fangs in the front of the upper jaw. Others also squirt the poison at the victim's eyes. In these kinds, the fangs are shaped so that the poison is sent forward when the cobra tilts back its head. This "spitting" is most developed in two African cobras and one East Indian. The venom harms human beings only if it gets in their eyes. The venom causes severe irritation and even blindness if not washed out immediately. A cobra bite may cause death in a few hours.

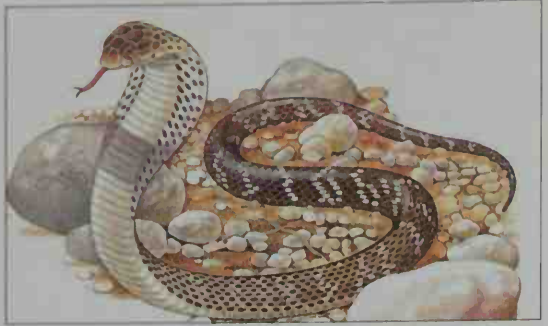
A full-grown Indian cobra is nearly 6 feet (2 meters) long and about 6 inches (15 centimeters) around. Its color ranges from yellowish to dark brown. On the back of its hood, it has a mark like a pair of spectacles. It is sometimes called "spectacled cobra."

Most cobras eat many kinds of animals, such as frogs, fishes, birds, and various small mammals. A dangerous



Wide World

Ty Cobb was one of the first players elected to the National Baseball Hall of Fame. His lifetime batting average was .367.



WORLD BOOK illustration by Robert Lewington, The Garden Studio

An Indian cobra may grow to nearly 6 feet (2 meters) in length. The snake's color ranges from yellowish to dark brown. It has a mark like a pair of spectacles on the back of its hood.

enemy of the cobra is the tiny mongoose. This animal attacks and usually kills the snake. See Mongoose.

Cobras live in Africa, southern Asia, and the East Indies, including the Philippine Islands. The *king cobra* of southeastern Asia is by far the largest of the group, and the longest poisonous snake known. It reaches a length of 18 feet (5.5 meters). It has a narrow hood. Most king cobras retreat from people and will attack only when they are surprised while guarding their eggs.

Cobras are found in various types of country, and may even enter houses. Cobras are not so dangerous as generally believed, because of the way they attack. Unlike rattlesnakes and other vipers, cobras prepare for battle by lifting up the front of the body without curving it like an S. Thus, an opponent can well judge how far a forward jab will reach. A person can easily knock down a rearing cobra by swinging a level stick. The cobra's fangs do not deliver the poison nearly so well as the viper's. The cobra's are shorter, and cannot be folded back. But cobras often chew an object after they have seized it. This habit helps inject the poison.

The jugglers and snake charmers of India usually use the cobra because of its unusual hood and its habit of rearing upright. They pretend to charm snakes with music, but the snakes can hear only a limited range of sounds and cannot hear the music. When they are being "charmed," they are only holding themselves on guard. They would do that without the music. Albert F. Bennett

Scientific classification. Cobras belong to the terrestrial poisonous snake family, Elapidae. The scientific name for the Indian cobra is *Naja naja.* The king cobra is *N. hannah.*

See also Asp; Snake (picture: King cobra); Snake charming; Snakebite.

Coca, *KOH kuh,* is the name of a large group of tropical South American shrubs or small trees. Coca plants grow about 3 to 12 feet (0.9 to 3.7 meters) tall. Two species of coca shrubs are cultivated as drug plants—the *Huánuco* coca, also called *Bolivian coca;* and the *Colombian coca.* The Huánuco coca is a greenish-brown plant with shiny, thick stems. The leaves are about 1 to 3 inches (2.5 to 7.6 centimeters) long with smooth edges. The Colombian coca is pale green and has smaller leaves.

The leaves of both the Huànuco and Colombian coca plants contain several drugs used in medicine as *anesthetics* (painkillers). These drugs include cocaine, tropacocaine, and hygrine. Cocaine also is illegally used for nonmedical purposes. Such use of cocaine can be hazardous and addictive (see Cocaine). South American Indians chew coca leaves with lime to improve endurance. The drugs in the leaves keep them from feeling tired or hungry, but they do not nourish the body.

James E. Simon

Scientific classification. Coca plants belong to the coca family, Erythroxylaceae. The scientific name for the Huánuco coca is *Erythroxylum coca.* The Colombian coca is *E. novogranatense.*

Coca-Cola Company is the world's largest producer of soft drinks. The company manufactures syrups and concentrates for Coca-Cola, also known as "Coke," and for more than 230 other soft drink brands. The red-and-white script "Coca-Cola" logo is among the most widely recognized corporate trademarks in the world.

John Styth Pemberton, a pharmacist in Atlanta, Georgia, invented Coca-Cola in 1886. He formed the Coca-Cola Company to produce the soft drink. Asa G. Candler, an Atlanta businessman, bought the company in 1891. Under him, the company expanded quickly. Within four years, Coca-Cola was available in every state and territory of the United States. Today, the Coca-Cola Company has operations in nearly all the countries of the world.

The Coca-Cola Company is headquartered in Atlanta. Its soft drink brands include Barq's, Fanta, Mr. Pibb, and Sprite. The company also owns the Minute Maid Company, a major marketer of juices and juice drinks.

Critically reviewed by the Coca-Cola Company

See also Advertising (illustration: Advertising over many years).

Cocaine, *koh KAYN,* is a powerful drug made from leaves of the coca shrub of South America. United States laws forbid the importation, manufacture, and use of cocaine for nonmedical purposes. But many people obtain it illegally and use it for its pleasurable effects. Such use can be dangerous, with users developing a compulsive desire for and dependence on the drug.

Medical use of cocaine in the United States is extremely limited. A few surgeons prescribe cocaine as a local *anesthetic* (painkiller) during certain kinds of surgery. They prefer cocaine because, in addition to blocking pain sensations, it causes small arteries to tighten, thus reducing bleeding during surgery.

Illegal use of cocaine has increased rapidly since the 1970's. Most users of the drug seek the feeling of intense pleasure, known as a *high,* that occurs for a short period after taking cocaine. Many people take the drug in social settings, using it because their friends do.

Illegal cocaine is a white powder that consists of cocaine hydrochloride—the active ingredient—mixed with other compounds. It is most commonly taken by "snorting" a small amount into the nose, where it is absorbed through the nasal lining. Some cocaine users inject the drug into a vein to produce more rapid and powerful effects. Just as rapid and even stronger effects are obtained by smoking a type of cocaine called *freebase.* Cocaine is also smoked in a potent pellet form called *crack.* The injecting and the smoking of cocaine account for most drug-related medical emergencies.

Physical and psychological effects. Cocaine is a *stimulant*—that is, it increases the activity of the nervous system. Cocaine causes sudden increases in heart rate and blood pressure. It also produces a feeling of euphoria (a sense of well-being). People feel alert and power-

ful, and their thinking seems better and clearer than usual. Occasionally, strong feelings of anxiety and fear occur instead of the expected high.

Cocaine use can be extremely habit-forming. When the drug's effects wear off, usually after 20 to 40 minutes, people often feel depressed and take another dose to try to regain the euphoria. Habitual users may come to feel that nothing is enjoyable without cocaine.

The long-term use of cocaine may cause some people to suffer depression or *psychosis* (severe mental breakdown), which makes them unrealistically suspicious or fearful. These symptoms may continue for weeks or months, even after a person has stopped using the drug.

History. The Andean Indians of South America have chewed coca leaves for thousands of years. This practice does not produce a high, but it does reduce fatigue and hunger, and it helps the Indians work more effectively in the high altitude of the mountains.

A German scientist discovered how to extract cocaine from the coca leaves in the mid-1800's. Many physicians at first considered it a miracle drug. During the late 1800's, doctors prescribed cocaine for all sorts of physical and mental ailments, including exhaustion, depression, alcoholism, and morphine addiction. Many of the patent medicines of the day contained cocaine.

Unfortunately, overuse caused many people to become dependent on the drug, and complications surfaced. By the mid-1900's, medical and nonmedical use of cocaine had become far less common. During the 1970's, however, claims of the drug's harmlessness and exciting effects triggered renewed popularity for its illegal use. As use of the drug increased, the number of cocaine-related problems also increased. In the 1980's, concern over cocaine use helped trigger widespread antidrug movements in the United States. Mark S. Gold

See also **Coca; Drug abuse.**

Cochise, *koh CHEES* or *koh CHEEZ* (1800?-1874), was an American Indian chief who fought white settlers in what are now Arizona and New Mexico. He led the Chiricahua band of the Apache Indians. The name *Cochise* means *firewood* in Apache.

During the 1850's, the Chiricahua were friendly with the whites. The peaceful relations ended in 1861, when Cochise was falsely accused of kidnapping a settler's child. The United States Army captured Cochise and several members of his tribe and ordered him to return the child. Cochise escaped, but the troops seized six Chiricahua and threatened to kill them if the child was not returned. Cochise then took several whites as hostages and offered to exchange them for the captured Apache. The Army refused, and so Cochise hanged his hostages. He then went to war against the settlers.

In 1867, a frontiersman named Thomas J. Jeffords went to Cochise's camp and persuaded him to let mail carriers pass through the Indian land. In 1869, Jeffords led General Oliver O. Howard to Cochise to discuss peace. Cochise agreed to stop fighting and moved his band to a reservation in Arizona. Edgar Perry

Additional resources

Schwarz, Melissa. *Cochise.* Chelsea Hse., 1992.
Sweeney, Edwin R. *Cochise.* 1991. Reprint. Univ. of Okla. Pr., 1995.

Cochran, *KAHK ruhn,* **Jacqueline** (1912-1980), was an American businesswoman and pioneer airplane pilot. She started flying in 1932, and was the only woman in the McRobertson London-Melbourne Race in 1934. Cochran also became the first woman to compete in the Bendix Trophy Race, which she won in 1938. During World War II (1939-1945), she organized and commanded the Women Airforce Service Pilots (WASP's). In 1945, she became the first civilian woman to receive the Distinguished Service Medal. Cochran owned a cosmetics firm from 1935 to 1963. In 1971, she was elected to the National Aviation Hall of Fame. She was born in Pensacola, Florida. Richard P. Hallion

Cock-of-the-rock is the name of two species of South American birds. One species lives in rocky ravines near mountain streams in the Andes from Colombia to Bolivia. The other lives in the mountains from Colombia to French Guiana and in northern Brazil. The male has rich orange or red plumage and a large crest on its head.



San Diego Zoo

Cocks-of-the-rock live in South America. The female, *left,* has dull colors. The male, *right,* has bright orange feathers.

The female is dull-colored. At the mating season, males gather in a cleared spot in the forest, where they dance and call to attract females. The female makes its nest of plant fibers that it glues with resin and attaches to crevices on rocks. Cocks-of-the-rock feed on fruit.

Stuart D. Strahl

Scientific classification. Cocks-of-the-rock make up the genus *Rupicola* in the family Cotingidae.

Cockatiel, *KAHK uh TEEL,* also spelled *cockateel,* is a type of parrot. It lives throughout Australia, except in coastal areas. The cockatiel is about 12 $\frac{1}{2}$ inches (32 centimeters) long and has a crown of feathers on its head and a long, tapered tail. Cockatiels are mostly gray. The male has a bright yellow head with an orange ear patch on each side. The female has duller head colors.

The cockatiel lives in open country and is often



WORLD BOOK illustration by John F. Eggert

Male cockatiel

found in trees bordering rivers or streams. Its favorite foods are seeds, grain, fruit, and berries, so farmers consider it a nuisance. The cockatiel is a popular pet. It may learn to "speak" a few words. John W. Fitzpatrick

Scientific classification. The cockatiel belongs to the family Psittacidae. It is *Nymphicus hollandicus.*

See also Parrot.

Cockatoo, *KAHK uh TOO* or *KAHK uh TOO,* is the name of several large parrots. Cockatoos live in Australia, New Guinea, and neighboring islands. Unlike most other parrots, cockatoos have a crest of feathers that can be raised and lowered. A cockatoo's coloring may be combinations of white, black, red, rose, or gray. The bird has a powerful, curved bill and a thick tongue. It has strong feet with which it climbs about the branches of trees.

Cockatoos feed on seeds, nuts, and fruits. These birds are serious pests in regions where there are many orchards. They are often seen in large flocks that fly swiftly.



WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

Cockatoos are large parrots. The species shown here are the palm cockatoo, *left,* and the sulfur-crested cockatoo, *right.*

Although they rarely learn to talk and often scream loudly, cockatoos make amusing pets because they can perform stunts and acrobatics. John W. Fitzpatrick

Scientific classification. Cockatoos belong to the family Psittacidae.

See also Parrot.

Cockcroft, Sir John Douglas (1897-1967), a British nuclear physicist, won the 1951 Nobel Prize in physics with Ernest T. S. Walton for being first to disintegrate atomic nuclei with artificially accelerated particles. In 1932, Cockcroft and Walton bombarded lithium nuclei with high-speed protons, producing two helium nuclei in the reaction. During World War II (1939-1945), Cockcroft ran an atomic research laboratory near Montreal, Canada. After the war, he led the British Atomic Energy Research Establishment. In 1959, he became the first head of Churchill College of Cambridge University. In 1961, he won the Atoms for Peace Award. He was born in Todmorden, near Huddersfield. Roger H. Stuewer

See also **Particle accelerator; Walton, Ernest T. S.**

Cocker spaniel, sometimes called the *American cocker,* is one of the most popular dogs in the United States. Cockers are favorite pets and show dogs. They are named for their ability to hunt birds called woodcock. However, few cockers are now used as hunting dogs. Most weigh 22 to 28 pounds (10 to 13 kilograms) and stand about 15 inches (38 centimeters) at the shoulder. Cockers have a soft, thick coat with *feathers* (long hairs) on the ears, chest, and legs. Many cockers have coats that are solid black or black with tan markings. Cockers with coats of *a*ny *s*olid *c*olor *o*ther than *b*lack—and also nonblack cockers with tan markings—are called *ascobs.* Cockers with red and white, black and white, or three-colored combination coats are called *parti-colors.* See also **Dog** (picture: Sporting dogs).

Critically reviewed by the American Spaniel Club

Cockfighting is a sport in which two *gamecocks* (fighting roosters) battle each other to the death. The sport is illegal in most of the United States, in Canada, and in many other countries. It is sometimes carried on secretly. Cockfighting is a popular public sport in Spain, Latin America, and part of the Orient.

Gamecocks are specially bred to achieve physical power, speed of movement, courage, and the killer instinct. They usually are brightly colored and have long spurs on their legs. But breeders generally trim the spurs down and attach artificial spurs to the gamecocks' legs. The spurs are usually steel, brass, or bone. The birds use them to rip and tear at their opponents.

A cockfight takes place in an enclosed pit, usually outdoors. Spectators place bets on their favorite gamecocks. At the start of the fight, handlers hold their birds firmly and allow them to peck at each other. When the birds are angry, they are released and start to fight.

Cockfighting probably began in Asia thousands of years ago. The sport came to ancient Greece and Rome by way of India and China. It spread throughout Europe. During the 1600's, the sport became popular in England, where the training and breeding of fighting cocks became an important industry. Don B. Wilmeth

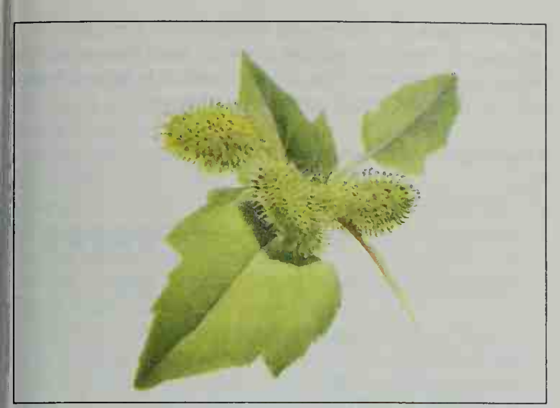
Cockle is the name of a common group of clams. Cockles have a hard, protective shell consisting of two pieces called *valves.* The valves are round and have deep grooves. There are about 200 kinds of cockles worldwide. Most live in shallow ocean waters, but some occur as deep as 1,000 feet (300 meters). Cockles move about by using a long, muscular organ called a *foot.* The foot can flip a cockle short distances or help it burrow beneath the sandy ocean bottom. Cockles range from about $\frac{1}{3}$ to 8 inches (1 to 20 centimeters) in diameter.

Robert S. Prezant

Scientific classification. Cockles are in the phylum Mollusca, class Bivalvia, family Cardiidae.

Cocklebur is the name of certain species of annual weeds belonging to the composite family. They all have spiny burs, and there are usually two seeds in each bur. One seed begins to grow a season before the other seed. Hooked prickles that cover the burs stick to clothing and fur. Cocklebur seedlings are poisonous and can kill hogs and young cattle that graze on them.

Cockleburs are native to North America. They are found in low areas in fields and by roadsides. Cockleburs grow from 1 to 3 feet (30 to 91 centimeters) tall, and their rough leaves are heart-shaped or irregular. Some



WORLD BOOK illustration by Robert Hynes

The cocklebur has spiny, prickly burs.

of the flowers of the cocklebur bear pollen, while others develop burs that bear seeds. The pollen-bearing flowers grow on the upper branches, and the seed-bearing ones grow on the lower. To get rid of cockleburs, the plants must be destroyed before the seeds ripen.

Margaret R. Bolick

Scientific classification. Cockleburs make up the genus *Xanthium* in the composite family, Asteraceae or Compositae.

Cockney is a nickname for a citizen of London, particularly one from the East End area. According to tradition, a cockney is anyone born within the sound of the bells of St. Mary-le-Bow Church. *Cockney* also applies to a dialect of English. Speakers change certain vowel sounds; for example, *lady* becomes *lydy* and *road, rowd.* They also drop the *h* at the start of words, and may add one in a word starting with a vowel; for example, *ard* for *hard* and *hanswered* for *answered.* The word *cockney* originally meant a misshapen egg. See also **London** (The people). Robert E. Dowse

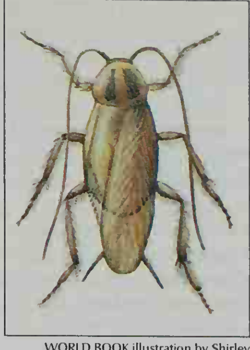
Cockroach is an insect best known as a household pest. It is closely related to grasshoppers and crickets. Cockroaches have lived on the earth for about 250 million years. There are over 3,500 species found throughout the world. They live in a variety of places, from tropical rain forests to deserts. About 20 species live in human dwellings and are considered pests.

Cockroaches have flat, oval bodies and long legs covered with bristles that serve as a sense of touch. Many cockroaches fly, and all run fast. These insects have long *antennae* (feelers) that provide a sense of smell.

Cockroaches are scavengers. They eat all kinds of food and many other substances, including paper, soap, plants, and dead animals. The pest species can live in almost any dwelling as long as the temperature is over 65 °F (18 °C) and water is available. They can be a serious problem in apartments, hospitals, and restaurants. Most cockroaches avoid light and are active chiefly at night. If they live in a dirty place, they carry germs.

Most species of cockroaches are found outdoors. In tropical rain forests, cockroaches may live on the forest floor or high in the trees. Some of these tropical cockroaches grow to 5 inches (13 centimeters) long, and many are brightly colored. Cockroaches frequently inhabit caves with bats.

Cockroaches found in United States homes include the *German cockroach, American cockroach, Australian cockroach, brown-banded cockroach,* and *Oriental cockroach.* The most common of these pest cockroaches is the German cockroach, also called the *Croton bug.* It got its name after it was found in large numbers in the Croton waterworks system in New York City in the mid-1800's. The adults are pale tan and about $\frac{1}{2}$ inch (1.3 centimeters) long. Every 25 days, the females lay egg cases containing about 32 young. The young become adults in about three months. This cockroach is highly adaptable and resistant to many pesticides.



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

Cockroach

Since the mid-1980's, a species called the *Asian cockroach* has become established as a pest in Florida and neighboring states. This cockroach, which is native to southeast Asia, is closely related to the German cockroach. Unlike most other species, the Asian cockroach is attracted to lights and bright surfaces. In addition, it is frequently found outdoors.

To keep cockroaches at a minimum in the home, keep the rooms clean and dry. Fix leaky faucets, do not overwater house plants, and do not leave out water or dried food for pets. Do the dishes before going to bed at night and store food in sealed containers. Throw away old paper bags and newspapers to avoid creating hiding places for cockroaches. Do not use any pesticide unless it has been approved for use in the home.

Betty Lane Faber

Scientific classification. Cockroaches make up the order Blattaria. The scientific name for the German cockroach is *Blattella germanica.* The Asian cockroach is *B. asahinai.*

Cockscomb is a flower with white, yellow, red, or purple heads shaped like a rooster's comb or like an os-



WORLD BOOK illustration by Christabel King

Cockscombs have crested or feathery clusters of white, yellow, red, or purple flowers. People often grow them in gardens.

trich plume. It comes from tropical America and Asia, but people now grow the plant throughout much of the world. Cockscombs will bloom from midsummer until the fall frost if planted in light, rich soil that is kept damp.

Anton A. Reznicek

Scientific classification. Cockscombs belong to the amaranth family, Amaranthaceae. They are *Celosia cristata.*

Cocktail. See Alcoholic beverage (Distilled beverages).

Cocoa. See Chocolate.

Cocoa butter. See Chocolate (Manufacturing).

Coconut. See Coconut palm.

Coconut palm is the tall, graceful tree on which the coconut grows. It probably is native to Southeast Asia and the islands of Melanesia in the Pacific Ocean. But it has been introduced into all the tropical and subtropical parts of the world. It stands from 40 to 100 feet (12 to 30 meters) high. Large featherlike leaves spread from the top of its branchless trunk.

The coconut palm is one of the most useful trees. People in the tropics build houses and bridges from its wood. They use whole leaves to make thatch roofs, and strips of leaves to make hats, mats, and baskets. They also make a sweet drink called *toddy* or *tuba* from the sap of the tree's blossoms. They also use this sap to make sugar, vinegar, and an alcoholic beverage.

The coconut is the fruit of the coconut palm. Clusters of these large round fruits grow among the leaves of the tree. Each coconut has a smooth light-colored *rind.* Under the rind is a 1- to 2-inch (2.5- to 5-centimeter) *husk* of reddish-brown fibers. The husk and rind surround a brown, woody shell that has three soft spots called *eyes* at one end. The rind and husk are usually cut away before the coconuts are marketed.

The coconut seed lies inside the shell. It is a ball of crisp, white, sweet-tasting coconut *meat* covered by a tough brown skin. Its hollow center holds a sugary liquid called coconut *milk.* The coconut seed measures from 8 to 12 inches (20 to 30 centimeters) long and from 6 to 10 inches (15 to 25 centimeters) across.

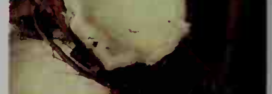
Leading coconut-growing countries

Tons of coconuts produced in a year

Country	Production
Indonesia	16,215,000 tons (14,710,000 metric tons)
Philippines	12,326,000 tons (11,182,000 metric tons)
India	10,950,000 tons (9,933,000 metric tons)
Sri Lanka	2,204,000 tons (1,999,000 metric tons)
Thailand	1,560,000 tons (1,415,000 metric tons)

Figures are for a three-year average, 1997-1999.
Source: Food and Agriculture Organization of the United Nations.





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Coconuts grow in clusters among the leaves of the coconut palm, *left.* The coconut seed lies inside the shell, *right.* It is a ball of crisp, white, sweet-tasting coconut meat covered by a tough brown skin. The seed's hollow center holds a sugary liquid.

Eric Hosking

Coconut palms are tall trees that produce coconuts. Large leaves spread from the top of the branchless trunks.

A well-tended tree produces about a hundred coconuts a year. Each fruit takes about a year to ripen. Ripe coconuts fall from the tree. However, on plantations, the coconuts are usually cut from the trees every two or three months.

Solid, dried coconut meat is called *copra*. Copra contains a valuable oil that is used for cooking and to make margarine and soap. Tropical lands produce millions of tons of copra each year. About 6,000 medium-sized coconuts make 1 ton (0.9 metric ton). To make copra, coconuts are split open and dried in the sun or in ovens. Some coconuts are dried by smoking.

Throughout the world, people enjoy eating crisp, juicy chunks of fresh coconut meat. Shredded and dried coconut meat adds a distinctive flavor and texture to candy bars and other foods. People in tropical lands also use the coconut husk. They weave the short, stiff fibers (called *coir)* of the husk into mats, ropes, and brooms.

Growing coconut palms. In the tropics, people can plant coconut palms all year. They half bury the coconut in a horizontal position. Within six months, a leaf sprouts from one of the eyes and pushes through the husk. The palm can be transplanted after one to four years. The palm will bear coconuts after seven or eight years. Coconut palms need much water and a temperature of at least 72 °F (22 °C) most of the year.

A disease called *lethal yellowing* has destroyed many coconut palms in Florida, Texas, Mexico, the Bahamas, and areas of the Caribbean. The disease is caused by microorganisms carried by insects called *planthoppers*.

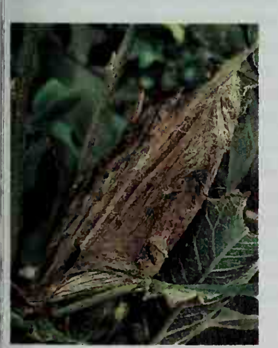
Alwyn H. Gentry

Scientific classification. The coconut palm belongs to the palm family, Arecaceae or Palmae. Its scientific name is *Cocos nucifera*.

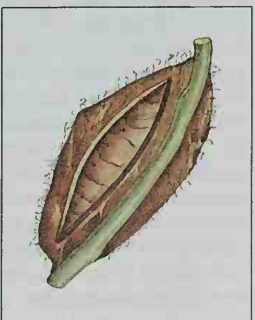
See also **Copra; Tree** (picture); **Palm** (Kinds of palms; picture: The coconut).

Cocoon is a protective covering that encloses the pupa and sometimes the larva of many insects. The mature larva prepares the cocoon as a shelter around itself. Inside the cocoon, the larva changes to a pupa and eventually transforms into an adult insect. Among the insects that spend part of their lives in cocoons are wasps, bees, caddis flies, moths, and some ants. Many spiders spin silk cocoons around masses of their eggs and sometimes around their prey.

The chief substance of most cocoons is silk. But the larva often incorporates other substances, including soil, sand grains, plant materials, and hair or waste from its own body. Some cocoons contain very little silk at all.



E. R. Degginger, Bruce Coleman Inc.



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

The cocoon of a *Cecropia* moth, *left,* is attached to a tree twig. The opened cocoon, *right,* reveals the pupa inside.

Most moth larvae (caterpillars) form cocoons. But many species pass the pupal stage in soil or in parts of plants without forming a cocoon. A few butterfly caterpillars make flimsy cocoons, but most pupate as a hard-shelled *chrysalis*. Perhaps the best-known cocoon is that of the caterpillar of the *Bombyx mori* moth, which supplies most of the world's commercial silk.

Most moth caterpillars build their cocoons in protected places in fallen logs, openings in tree bark, or among debris and fallen leaves. Cocoons of some large species, such as *Cecropia, Promethea,* and *Polyphemus* moths, are fastened to twigs of trees and can easily be found during winter. The pupae spend the winter inside the cocoon and secrete a dissolving fluid to emerge from the cocoon in spring or summer.

Other moths, including certain species of *tiger moths,* spend the winter as larvae and form cocoons in spring or summer before pupating. Some species of *clothes moths* form an incomplete cocoon or pupal case early in larval life and carry it on their backs as they feed. Later, they complete the cocoon and use it for their pupal stage. Charles V. Covell, Jr.

Related articles in *World Book* include:

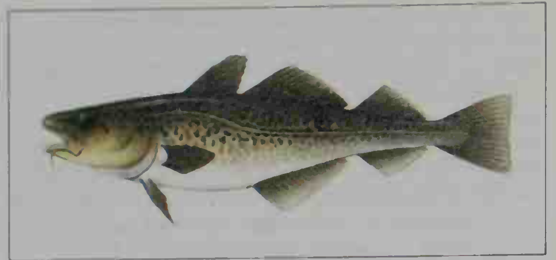
Caterpillar	Metamorphosis	Silk (Raising silkworms)
Chrysalis	Moth	
Larva	Pupa	

Cocteau, *kahk TOH* or *kawk TOH,* **Jean,** *zhahn* (1889-1963), a French writer, often used his many talents to shock the public. He had a great range of creativity and won fame as a poet, playwright, author of ballet plots, screenwriter, novelist, and artist. Cocteau defied the conventions of his time with an unorthodox private life, which included homosexuality and the use of opium. He also insisted that the artist occupies a central role in culture.

Cocteau frequently used the myths and dramatic plots of ancient Greece in his plays. *Orpheus* (1926) is a study of a poet's agonizing search for inspiration and his struggle to gain acceptance for his work. *The Infernal Machine* (1934) is an adaptation of Sophocles's *Oedipus Rex*. Its theme is that humanity's fate is controlled by dangerous powers that govern the universe. In Cocteau's fantastic style, these plays use unexpected colloquial phrases, events out of time sequence, and symbols explainable in terms of modern psychology.

Cocteau's best-known novel, *Les Enfants terribles* (1929), tells of four young people who create a sinister, unreal world of their own. He also created ballets, notably *Parade* (1917). He wrote and directed several films, including *The Blood of a Poet* (1932), *Beauty and the Beast* (1946), and *Orpheus* (1950). In his later years, he devoted his time to painting and to decorating chapels. Cocteau was born in Maisons-Laffitte. He was elected to the French Academy in 1955. Dora E. Polachek

Cod is a major food fish. It lives in the northern waters of the Atlantic and Pacific oceans. Cod belong to the codfish family, which also includes the pollock and the haddock. The codfish family is second only to the herring family in the amount of fish caught each year. But unlike herring, which are used largely for agricultural and industrial purposes, most cod are eaten by people.



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

The Pacific cod lives in the waters of the northern Pacific Ocean and the Bering Sea. It is an excellent food fish and has long been important to the fishing industry.

Appearance and habits. Cod have three fins on the back and two fins on the underside near the tail. A fleshy growth called a *barbel* extends from the end of the chin. Cod may be any color from gray to red to brown or black, with the upper parts marked with many small, dark spots. Most adult *Atlantic cod* range from 2 to 3 feet (0.6 to 0.9 meter) in length and weigh from 5 to 25 pounds (2.3 to 11 kilograms). But cod of up to 6 feet (1.8 meters) and 212 pounds (96 kilograms) have been recorded. The *Pacific cod* rarely exceeds 3 feet (90 centimeters) in length and usually weighs from 3 to 20 pounds (1.4 to 9 kilograms).

Cod live near the ocean floor, but they often swim up to midwater and sometimes approach the surface while feeding. The fish swim at an average speed of 4 miles (6 kilometers) per hour.

Cod *spawn* (produce eggs) offshore during the late winter and the early spring. A cod may spawn from 3 million to 8 million eggs at a time. But only a small percentage of the eggs develop into mature fish. The eggs of most species of cod rise to the surface and become part of the *plankton*—the mass of small, drifting aquatic organisms. The newly hatched fish feed on the plankton. When the cod are 1 to 2 inches (2.5 to 5 centimeters) long, they move to the ocean's bottom, where they feed on worms and small shrimp.

Some cod migrate in response to seasonal changes in water temperature. Cod also may migrate to spawn and to search for food. Mature cod eat small fish; squid; and shellfish, such as clams, crabs, and shrimp.

Cod fishing and marketing. There are 25 species of the codfish family found in North America, but not all of them are commonly called cod. Two important species are the Atlantic cod and the Pacific cod. The number of Atlantic cod in a given area varies because of seasonal migrations. In more southerly parts of its range, the fish is found only during the cold months. Cod fishing areas in the northeastern Atlantic are located around Iceland and in the Barents, Norwegian, Baltic, and North seas.

The Pacific cod ranges from the waters off California north to the Bering Sea and west to Japan and Korea. The best fishing grounds for Pacific cod are in the southeast Bering Sea. The United States is the leading country in catching Pacific cod. Russia ranks second, and Japan is third.

When cod is split, salted, and dried, it can be kept for long periods without spoiling. In past centuries, ships could not carry perishable food on long voyages because there was no refrigeration. Cod became an important food on such voyages. As early as the 1500's, European fishing crews crossed the Atlantic to catch cod. At first, the fish were caught with lines and bait. But since the 1600's, cod have been caught mainly with nets.

In the United States, the demand for cod increased sharply after the introduction of precooked codfish sticks in the 1950's. Since the early 1990's, Atlantic cod has declined greatly because of overfishing and improper management of cod stocks. Restrictions placed on cod fishing by the Canadian and U.S. governments in the 1990's were designed to help the species recover. However, cod remains a popular food fish in many parts of the world. Cod is also a source of cod-liver oil, a food supplement rich in vitamins A and D. Tomio Iwamoto

Scientific classification. Cod belong to the codfish family, Gadidae. The scientific name for the Atlantic cod is *Gadus morhua.* The Pacific cod is *G. macrocephalus.*

Code, in law, combines all the laws on a given subject in a single statute or ordinance. It is passed by a legislative body, such as a federal congress, a state legislature, a county board of supervisors, or a village board. It is purely *statutory law,* as distinguished from the *common law* that arises from court decisions.

In theory, it is possible for all the laws in a code to be *new* in the sense that no law has ever been passed dealing with the particular subject. But in practice, a code nearly always represents a systematic and comprehensive revision of all the laws that the legislative body has passed on a given subject.

Statutes usually develop only as problems arise that point out the need for new rules and regulations. The development of laws concerning automobiles is an example. The first rules set speed limits and required drivers to keep to the right. Then vehicles, and later drivers, were licensed. Many cities passed further rules without making them consistent with state laws. Such piecemeal legislation left gaps, uncertainties, and conflicts among the many separate regulations. As a result, most states revised their motor-vehicle laws, made them consistent, filled the gaps, and removed uncertainties. They enacted a single series of laws called a *Motor Vehicle Code.*

Other well-known codes include the federal criminal code, state commercial codes, and local or county building codes. Some villages combine all their laws into a *village code.* Sherman L. Cohn

Code Civil. See Code Napoléon.

Code Napoléon, *KAWD na paw lay AWN,* is the name often given to the code that contains the civil, as distinguished from the criminal, law of France. In 1800, Napoleon Bonaparte appointed a commission of jurists to combine all French civil laws into one code. The code went into effect in 1804. That same year, after Napoleon became emperor of France, the code became known as the *Code Napoléon.* But its official name is *Code Civil.*

The Code Napoléon represented a compromise between the customary law of northern France and the Roman law of the south. It also compromised between the ideas of the French Revolution and older ideas. It gave new liberty to the people, but kept such ideas as the system of inheritance. The Code Napoléon influenced law in Europe, South America, the state of Louisiana, and the province of Quebec. But its influence has declined. Even in France, the Code Napoléon has been changed by new laws and court decisions. David M. O'Brien

Code of Hammurabi. See Hammurabi.

Code of Justinian. See Justinian Code.

Code talkers were small groups of American Indians who served in the United States armed forces in World War I (1914-1918) and World War II (1939-1945). Code talkers developed and used codes in Indian languages to send secret messages. Their efforts helped the United States and its allies win both wars.

The best-known code talkers were Navajo radio operators during World War II. In 1942, the U.S. Marine Corps recruited 29 Navajo men to develop a code. More than 400 Navajo code talkers served in the war in the Pacific. On Japanese-held islands, such as Iwo Jima and Okinawa, the code talkers sent vital messages between front lines and command posts. The Japanese never broke the Navajo code.

Philip Johnston, an engineer raised on a Navajo reservation where his father was a missionary, suggested that the Marines use the Navajo language as the basis for a code. He chose Navajo because it was an unwritten language unknown to most non-Navajos. Its complex structure, difficult pronunciation, and singsong qualities made it nearly impossible to decipher.

Code talkers used familiar words to describe U.S. military terms. When referring to a fighter plane, they used the Navajo word for *hummingbird.* A destroyer became a *shark,* and bombs were *eggs.* Code talkers also developed an alphabet based on English words to spell names. One or more Navajo words could stand for each letter. For example, the Navajo word for *ant* indicated the letter *a, bear* signaled *b, cat* was *c,* and so on.

Several other American Indian groups also acted as code talkers. In World War I, about 19 Choctaw men served in the U.S. Army, sending and receiving messages based on the Choctaw language. During World War II, 17 Comanche men used their language for code in the U.S. Army Signal Corps. Catherine Jones

Codeine, *KOH deen,* also called *methylmorphine,* is a drug used to relieve pain and coughing. It is manufactured from morphine, a drug obtained from the opium poppy plant. This plant also contains some pure codeine, but not in quantities large enough to provide the amounts required for use in medicine.

Codeine is used to relieve pain of moderate severity. It is a much less powerful drug than morphine, which is generally used to ease extreme pain. Codeine provides cough relief at lower doses than those required for pain relief. The drug is usually taken by mouth and often combined with other painkilling medications, such as aspirin and acetaminophen.

People who use high doses of codeine for an extended period may become addicted to it. But individuals who become addicted to painkillers rarely start their drug habit with codeine. Codeine addicts who stop using the drug have much less severe withdrawal symptoms than do morphine addicts. Frank Welsch

See also **Morphine; Opium.**

Codes and ciphers are forms of secret communication. In general, a code replaces words, phrases, or sentences with groups of letters or numbers. A cipher rearranges letters or uses substitutes to disguise a message.

The technology of secret communication is called *cryptology.* It has two opposing parts: *communications security* and *communications intelligence.* People use communications security, also called *COMSEC,* to make messages secret. The study and practice of COMSEC methods is called *cryptography.* Communications intelligence, also called *COMINT,* consists of learning about messages without the permission of the communicators. COMINT includes eavesdropping, bugging rooms, wiretapping telephone conversations, and cracking the codes or ciphers of enemy forces. Solving such secret communications is called *cryptanalysis.*

In cryptology, the original message is called the *plaintext.* Its secret form is the *ciphertext* or *cryptogram.* The mathematical process that changes one into the other is the *cryptographic algorithm.* A *key* controls the operations of an algorithm. The receiver of a ciphertext must have been given the algorithm and key to convert the ciphertext back into plaintext. *Encrypting* is the process of converting plaintext into ciphertext. *Decrypting* is the process by which the intended receiver changes ciphertext back into plaintext.

There are two types of *cryptosystems,* or types of algorithms: (1) *secret-key* or *symmetrical* systems and (2) *public-key* or *asymmetrical* systems. In a secret-key system, the same key is used for both encryption and decryption. Anyone knowing the key can both encrypt and decrypt messages. In a public-key system, there are two keys. One key encrypts a message and another key decrypts it.

This article explains only encrypting procedures. From them, decrypting procedures can be determined.

Communications security

The letters, numbers, words, punctuation marks, and other symbols that make up a plaintext can be turned into secret form in only two ways. One method, called *transposition,* shuffles them. The other, *substitution,* replaces them with other characters. Simple ciphers treat the plaintext as letters and numbers and use transposition or substitution alone or in simple combinations to construct ciphertext. The sender often transmits the resulting ciphertext in *blocks* (groups) of an equal number of letters or numbers, regardless of the true word divisions, to help further conceal the plaintext. More complex ciphers first convert the plaintext into a sequence of numbers and then use combinations of transposition and substitution, along with arithmetic operations, to construct the ciphertext. The sender then often transmits the ciphertext as a continuous stream of numbers.

Transposition. A simple transposition reverses consecutive pairs of letters. In such a cipher, the message DO NOT DEPART would become ODOND TPERA T. A more secure form of transposition is *columnar* transposition. In this method, shown below, the coder writes the plaintext horizontally by lines under the key numbers and then takes out the coded message vertically by columns in the order of the key numbers.

4	1	2	5	3
a	w	a	i	t
m	y	o	r	d
e	r	s		

Thus, the message AWAIT MY ORDERS becomes WYRAO STDAM EIR.

Substitution. The simplest form of substitution is *monoalphabetic* substitution. It replaces each letter of the plaintext with a particular symbol. For example, if the substitute for *a* is *X*, all the *a*'s in the plaintext become *X*s in the ciphertext. The complete list of substitutes for the 26 letters may be set out in a *cipher alphabet*:

```
abcdefghijklmnopqrstuvwxyz
X7+PDM3UAJ6ZRC$G5NEBW%9HSK
```

The plaintext *attack* would become ciphertext XBBX+6. The ciphertext 3$ decrypts into *go*.

In *polyalphabetic* substitution, the coder replaces a plaintext letter with substitutes from several cipher alphabets rather than from a single one. A common substitution method uses a table like that at the bottom of this column. Correspondents may agree to use all 26 cipher alphabets of the table in turn, repeating them if the message is more than 26 letters long. In this method, the sender enciphers the first letter of the plaintext using the scrambled alphabet in line 1. The second letter uses that of line 2, and so on.

A more flexible method of polyalphabetic substitution employs a *key word* to specify the cipher alphabets to be used. If the key word is BOX, for example, the correspondents will use the cipher alphabets beginning with the letters B, O, and X in that order. To encipher, the coder writes the key word repeatedly above the plaintext. The substitute for each plaintext letter appears under that plaintext letter in the cipher alphabet that begins with its key letter:

key word	BOXBOXBOXBOXBO
plaintext	reportposition
ciphertext	JPTIVJUUNFLZII

The great advantage of the use of a key word is that correspondents can change it easily in case of overuse or actual or feared discovery. Its disadvantage is its regular repetition. One way of avoiding this repetition is to use a long phrase. Such a phrase is called a *running key*.

Polyalphabetic substitutions adapt easily to cipher machines and, in certain systems, are difficult to solve. They are thus among the most widely used ciphers.

	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o	p	q	r	s	t	u	v	w	x	y	z
1	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X
2	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G
3	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B
4	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O
5	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y
6	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R
7	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D
8	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P
9	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z
10	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E
11	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F
12	A	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q
13	H	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A
14	S	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H
15	T	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S
16	I	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T
17	U	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I
18	N	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U
19	J	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N
20	V	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J
21	C	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V
22	L	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C
23	W	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L
24	K	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W
25	M	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K
26	X	G	B	O	Y	R	D	P	Z	E	F	Q	A	H	S	T	I	U	N	J	V	C	L	W	K	M

In *polygraphic* substitution, the coder puts two or more letters into cipher as a unit. The *Playfair* algorithm, used during World War I (1914-1918) and World War II (1939-1945), starts with a 25-letter scrambled alphabet arranged in a 5-letter by 5-letter square. The algorithm enciphers plaintext letters in pairs according to their positions in relation to each other within the square. The *Hill Cipher* converts plaintext letters into numbers and then plugs them into algebraic equations. To encipher the text, the coder simply solves the equations.

Public-key systems involve mathematical problems that are easy to solve in one direction but hard to solve in the other. The most widely used public-key system is known as the RSA algorithm, named for its inventors, the computer scientists Leonard Adelman and Ronald L. Rivest of the United States and Adi Shamir of Israel. The algorithm is based on the fact that it is easy to multiply together two *prime numbers* (numbers evenly divisible only by themselves and the number one) but hard to find prime numbers after they have been multiplied together. The actual construction of the algorithm relies on the branch of mathematics known as *number theory*. Other public-key algorithms use other types of mathematical problems.

Cipher machines. Mechanical and electromechanical machines, as well as computers, can generate complex algorithms that people cannot work easily or accurately by hand. The most famous mechanical algorithm was invented by Boris C. W. Hagelin, a Swedish engineer. It shifts a cipher alphabet to various positions in a key sequence more than 100 million letters long. The U.S. Army used Hagelin's algorithm during World War II.

Electromechanical rotor machines are more powerful than mechanical machines. The "Enigma," used by the Germans during World War II, was the best known. This machine had an electric keyboard into which the plaintext was typed. The electric signal representing the plaintext letter passed through a succession of wired code wheels called *rotors*. This created an electric maze that changed as the rotors turned, thus constantly changing the encipherment.

Most coders today use computers to carry out algorithms. A general-purpose computer may run the algorithm software. Or, if speed or security is particularly important, engineers can build a specialized computer to carry out an algorithm.

Codes. Most codes fill a book, while a cipher can be written on a single piece of paper or embodied in a cipher machine. The cryptosystem is called a *code* if the plaintext elements consist not only of letters but also of hundreds of words, phrases, sentences, syllables, numbers, and punctuation marks. In the code, all these elements are replaced by groups of numbers or letters. For example, 77181 may mean *Wait for further instructions.*

Communications intelligence

Frequency analysis. Cryptanalysis is the process of studying the ciphertext to extract information about the plaintext. Statistics plays an important role in this process. Letters occur with varying frequency in English and other languages. The proportion of their frequency is remarkably stable. For example, in English, the letter *e* is

used more than any other (12 percent), followed by *t* (9 percent). If a cryptanalyst counts the letters of a long monoalphabetic substitution and finds that *X* is the most common, he or she assumes that *X* stands for *e*. The analyst replaces all the *X*s with *e*'s and starts to guess at words. For example, *e?e?* might be *even* or *ever*. In short messages, the most frequent letter may not be *e*.

Clues are also provided by *contacts*—that is, which letters stand to the right and to the left of a particular letter. For example, three high-frequency letters that rarely contact each other are *a, o,* and *i*. A high-frequency letter that follows vowels in 80 percent of its appearances is *n*. One that precedes vowels 100 times more often than it follows them is *h*. The five most common letter pairs are, in order, *th, he, in, er,* and *an*. The five most common words are *the, of, and, to,* and *a*.

Frequency analysis can also be applied to a cryptogram enciphered by polyalphabetic substitution. But the cryptanalyst must first identify the different cipher alphabets and their letters, then solve each key separately.

Unbreakable ciphers. A basic assumption of practical cryptography is that outsiders know the general system. Secrecy must reside only in the keys. For example, possession of a cipher machine should not permit a cryptanalyst to solve messages encrypted with it if he or she does not know the key settings.

Modern cryptosystems are designed so that frequency analysis has little effect against them. But even the most sophisticated cryptosystems are vulnerable to a "brute-force" attack. Such an attack tries every possible key until one is successful. The best protection against a brute-force attack is to make the number of possible keys so large that it is impractical to try all of them in a reasonable amount of time, even with the fastest available computers.

The only cryptosystem known to be unbreakable, even by brute-force attack, is called the *one-time pad*. Plaintext is first converted to a sequence of zeroes and ones (called "bits"). This stage may be performed by another cipher that represents the letters of the alphabet by batches of bits. Then the key, which consists of another sequence of zeroes and ones exactly as long as the plaintext, is constructed completely at random. For example, if the plaintext has 20 bits, one may choose the key by flipping a coin 20 times and recording heads as one and tails as zero. The ciphertext is made by writing the key above the plaintext and combining the bits according to the rules $0 + 0 = 0$, $0 + 1 = 1$, $1 + 0 = 1$, and $1 + 1 = 0$. For example:

key	00101000100101001101
plaintext	10010100010101001010
ciphertext	10111100110000000111

To recover the plaintext, the process is repeated by combining the bits of the ciphertext with the key according to the same rules. Because the key is random and just as long as the plaintext, it is impossible to analyze the ciphertext to recover any information. Trying all possible keys will yield all possible strings of zeroes and ones of the given length.

History

Documents indicate that secret writing arose independently in many civilizations as soon as writing became widely used. The Arabs first devised a science of cryptanalysis in the A.D. 700's, using letter frequencies.

Cryptology came into widespread use in the West during the 1300's, when ambassadors were first assigned residence in other countries. They frequently used codes to send confidential reports home and to get secret orders.

During the mid-1800's, the widespread use of the telegraph led to the development of *military field ciphers*. In the early 1900's, military forces sent many messages in cipher by radio. Because enemies could easily intercept these transmissions, cryptanalysis became a powerful intelligence force during World War I.

Possibly the most important single solution in history occurred during World War I. The British cryptanalyzed a message from the German foreign minister, Arthur Zimmermann, to the German ambassador in Mexico. It promised that if Mexico would fight the United States, Germany would see that Mexico got back its "lost territories" of Texas, Arizona, and New Mexico. This disclosure helped bring the United States into the war.

The enormous wartime burden of encrypting radiograms stimulated inventors to mechanize the work. In 1917, Gilbert S. Vernam, an American engineer, automated cryptography by joining an electromagnetic ciphering device to a teletypewriter. Using a key of punched tape, the mechanism encrypted the plaintext and transmitted the cryptogram. A receiving cipher teletypewriter automatically decrypted the ciphertext and printed out the plaintext. In 1918, Joseph O. Mauborgne, a U.S. Army major, devised the one-time pad. About the same time, the rotor was invented independently by both Edward H. Hebern, an American businessman, and Arthur Scherbius, a German electrical engineer.

Later developments. In 1932, Marian Rejewski, a Polish mathematician, aided by information from a spy, solved the coding procedures of Scherbius's machine, the Enigma. During World War II, the British used Rejewski's solution to decrypt German messages. United States and British codebreakers helped defeat German submarines in the Atlantic Ocean. In the Pacific Ocean, cryptanalysis played a crucial role in sinking Japan's merchant marine fleet. Codebreaking enabled Allied forces to identify and shoot down the airplane carrying Admiral Isoroku Yamamoto, Japan's chief naval leader. Cryptanalysis also led to victories against German forces in North Africa and Europe. The code solutions hastened the defeats of Germany and Japan and shortened the war by months. See World War II (The Ultra secret).

In 1971, Martin Hellman, an electrical engineer at Stanford University, and his student Whitfield Diffie published the concept of asymmetric, or public-key, ciphers. The first practical realization of this concept was the RSA algorithm, developed in 1977 at the Massachusetts Institute of Technology by Rivest, Shamir, and Adelman.

Since the 1970's, the use of cryptography in private business has grown rapidly. In 1977, the U.S. government approved a secret-key system that uses a complicated electronic transposition-substitution algorithm called the Data Encryption Standard (DES). DES was designed to protect data stored in or transmitted between computers. During the 1990's, the tremendous increase

in computer speed made DES vulnerable to brute-force attacks. A new algorithm called the Advanced Encryption Standard (AES) replaced DES in many electronic commerce applications.

Modern applications of cryptography include the encryption and decryption of information sent via cellular telephone or the Internet. In both types of communication, cryptography provides a way to protect the privacy of the transmitted information. For example, in an *e-commerce* (electronic commerce) transaction on the Internet, it prevents wrongdoers from intercepting credit card numbers or other personal data. An application called *cryptographic authentication* is used to verify that a person transmitting or receiving information is who he or she claims to be.

Digital cellular telephones encrypt voice transmissions to prevent eavesdropping. A cell phone must also identify the caller so that the phone center can bill the correct person for the call. Identity authentication involves the use of a secret key and algorithm. Each time a call is placed, the phone center sends a different random number, called a *challenge,* to the caller's phone. A secret key stored in the phone, and shared by the phone center, encrypts the challenge and returns it. If the response agrees with the center's encryption, the center accepts the caller as legitimate. Jeremy Teitelbaum

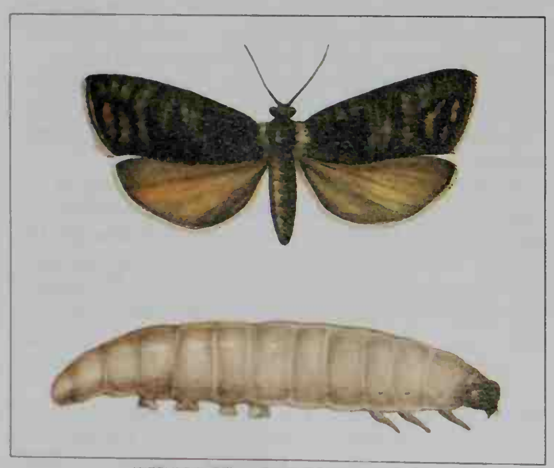
See also Code talkers.

Additional resources

Kippenhahn, Rudolf. *Code Breaking.* Overlook, 1999.
Newton, David E. *Encyclopedia of Cryptology.* ABC-Clio, 1997.

Codling moth is a small brown and bronze-colored moth. The caterpillars of this moth cause severe damage to apples and other fruits, such as pears, quinces, and English walnuts. Originally a native of Europe, the codling moth now lives in all parts of the world.

In spring, the adult moths emerge from their cocoons under loose bark and trash. They lay their eggs on leaves and twigs. The *larvae* (caterpillars) bore into young apples. This usually causes the fruit to die and drop off. A second or, in some areas, even a third generation of larvae may bore into larger apples.



WORLD BOOK illustration by Shirley Hooper, Oxford Illustrators Limited

The codling moth is a small brown and bronze-colored moth. As a caterpillar, it can cause damage to apples and other fruit.

The chief method of controlling codling moths is by a series of four to seven sprayings with insecticide. Some growers use traps baited with a special *pheromone* (chemical substance) that attracts male moths. These traps help growers judge the best time to spray. Orchards and packing sheds should also be kept clean of all loose bark, fallen apples, and trash. John R. Meyer

Scientific classification. The codling moth belongs to the family Tortricidae. Its scientific name is *Cydia pomonella.*

Cody, William Frederick. See Buffalo Bill.

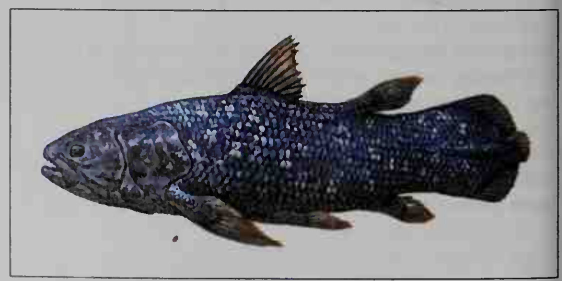
Coeducation is the teaching of males and females together in the same class or school. In many countries, coeducation is uncommon, especially in high school. But in the United States, most schools are coeducational. A few private schools admit students of only one sex. Most of these schools are operated by religious groups.

Most early schools in the United States enrolled only boys and men. Many people thought women had weaker minds than men and would be disturbed by too much education. But during the 1800's, new educational opportunities opened up for girls and women. Oberlin College, founded in 1833 as Oberlin Collegiate Institute, became the first coeducational college in the United States. Several women's colleges also were established. Mount Holyoke Female Seminary (now Mount Holyoke College) opened as a school for women in 1837. By 1850, it offered a curriculum similar to that of men's colleges. Vassar College, another early women's college, was founded in 1861. By the mid-1800's, a number of high schools had become coeducational. By 1882, public elementary schools had begun to admit boys and girls.

During the mid-1900's, most private men's and women's colleges became coeducational. They did so primarily to attract more students but also to meet demands made by the women's rights movement. In addition, government regulations cut off federal funds to schools that discriminated on the basis of sex. However, some women's colleges, including Mount Holyoke and Smith, chose to remain all-female schools. Officials of these colleges believed women could better develop leadership and other abilities if they did not have to compete with men. Helen S. Astin

See also Education (Education for whom?).

Coelacanth, *SEE luh kanth,* is a primitive type of fish found in the Indian Ocean. Some coelacanth fossils date from more than 300 million years ago. Scientists believed these fish had been extinct for 80 million years until one coelacanth was caught off the coast of South Africa in 1938. Since then, many more coelacanths have been caught. Coelacanths are members of an ancient group of fishes known as *sarcopterygians.* Lungfishes



WORLD BOOK illustration by John D. Dawson

The coelacanth lives in the Indian Ocean.

are the only other surviving members of this group. See **Fish** (The Age of Fishes).

Coelacanths are dark brown to blue-gray in color. They grow to more than 6 feet (1.8 meters) in length and weigh up to 210 pounds (95 kilograms). Coelacanths have muscular, limblike fins on the underside of their body. They feed on squid and various fishes. Unlike most fish, the female coelacanth does not lay eggs. She gives birth to live young. John E. McCosker

Scientific classification. Coelacanths belong to the class of bony fish, Osteichthyes. They make up the coelacanth family, Latimeriidae.

Coelenterate. See **Cnidarian.**

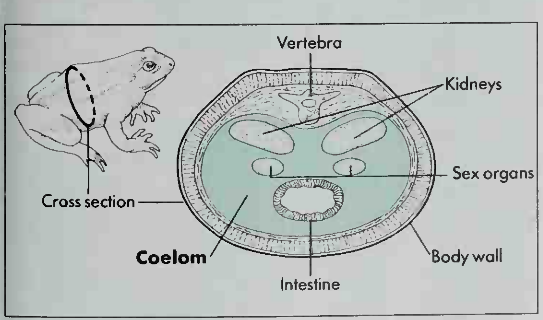
Coelom, *SEE luhm,* is the body cavity of vertebrates and higher invertebrates. The coelom is important in distinguishing the lower animal phyla from the higher phyla. A number of internal organs, such as the liver and the kidneys, are contained within the coelom.

Animals that have a coelom are called *eucoelomates.* They have a body plan that can be described as a "tube within a tube." The digestive tract forms the inner tube, and the body wall forms the outer tube. The coelom is the space between the tubes. This arrangement results from the animal's development as an embryo.

In its early stages, the embryo consists of a hollow sphere of cells called the *blastula.* The cavity within the blastula is called the *blastocoele.* Eventually, the cells at one point on the blastula begin to *invaginate*—that is, they start to fold inward into the blastocoele. This tube-like invagination forms a primitive gut, lined by a layer of cells called *endoderm.*

The cells on the outer wall of the blastula make up a layer called the *ectoderm.* A third layer of cells, the *mesoderm,* develops between the ectoderm and endoderm. The mesoderm completely fills what remained of the blastocoele. The coelom, a totally new cavity, develops within the mesoderm and, therefore, is lined entirely by mesodermal cells.

Certain lower invertebrates have a tube-within-a-tube body plan but lack a true coelom. These *pseudocoelomates,* including roundworms and rotifers, have a body cavity that serves some of the functions of a true coelom. In pseudocoelomate embryos, the mesodermal cells do not completely fill in the blastocoele. The blastocoele is retained and becomes the body cavity in the adult animal. Unlike a true coelom, this pseudocoelom is not lined completely by mesoderm.



WORLD BOOK diagram by Marion Pahl

The coelom is the body cavity between the digestive tract and the body wall. All vertebrates and higher invertebrates have a coelom, in which various internal organs are located.

Invertebrates called *acoelomates,* which are simpler than pseudocoelomates, have a solid mesodermal layer with no body cavity. Flatworms and ribbon worms are acoelomates. G. J. Kenagy

Coercive Acts. See **Intolerable Acts.**

Coeur d'Alene Mountains, *KUR duh LAYN,* form the northern part of the Bitterroot Range of the Rocky Mountains. They are also called the Bitterroot Mountains. They extend for about 40 miles (64 kilometers) along the Idaho-Montana border. For location, see **Idaho** (physical map). The Coeur d'Alene Mountains look like a rolling upland cut by many streams, and have few prominent peaks. Ridge elevations vary from 5,200 to 6,800 feet (1,580 to 2,070 meters) above sea level.

Harley Johansen

Coffee is a drink made from the roasted and ground beans of the coffee plant. It is the favorite hot drink in almost every country in the world.

The United States ranks as the largest consumer of coffee. Americans drink about 400 million cups every day. The rich aroma of coffee adds much to the pleasure of drinking it. The *coffee break* has become an integral part of the business world. Each morning and afternoon, millions of workers pause for a few minutes of relaxation over a cup of coffee.

On the average, each person in the United States drinks the brew from about 10 pounds (4.5 kilograms) of coffee annually. Each year, the United States uses about 2,800,000,000 pounds (1,270,000,000 kilograms) or about one-fifth of all the coffee grown in the world. Other leading coffee-consuming countries include Brazil, France, Germany, Italy, Japan, and the United Kingdom. Brazil produces about a fourth of the world's coffee crop. Vietnam and Colombia rank next in production. Coffee is vital to the economies of many developing countries.

From bean to cup

The coffee plant. The scientific name of the common coffee plant is *Coffea arabica.* It originally grew wild in Ethiopia. It is now cultivated in Java, Sumatra, India, Arabia, equatorial Africa, Hawaii, Mexico, Central and South America, and the West Indies.

Coffea arabica is a shrub with glossy, evergreen leaves. It is 14 to 20 feet (4.3 to 6.1 meters) high when fully grown. As a rule, coffee growers prune it to under 12 feet (3.7 meters). Its white flowers are self-pollinating.

The coffee fruit is called a berry. It begins to grow while the plant is blossoming and ripens from green to







Giuseppe Mazza   Dave Cormier, DPI

Coffee comes from berries, *left,* that grow on a shrub. Each berry contains two beans. Roasted beans, *right,* are ground up and brewed with hot water to make coffee.

Leading coffee-growing countries

Amount of coffee beans produced in a year

Country	Production
Brazil	3,891,000,000 pounds (1,764,900,000 kilograms)
Vietnam	1,626,000,000 pounds (737,400,000 kilograms)
Colombia	1,379,000,000 pounds (625,300,000 kilograms)
Indonesia	886,000,000 pounds (402,100,000 kilograms)
Côte d'Ivoire	805,000,000 pounds (365,000,000 kilograms)
Mexico	731,000,000 pounds (331,800,000 kilograms)
India	631,000,000 pounds (286,100,000 kilograms)
Guatemala	589,000,000 pounds (267,200,000 kilograms)
Ethiopia	507,000,000 pounds (230,000,000 kilograms)
Uganda	466,000,000 pounds (211,200,000 kilograms)

Figures are for a three-year average, 1999-2001.
Source: Food and Agriculture Organization of the United Nations.

yellow to red. The average plant produces enough berries each year to make about 1 ½ pounds (0.7 kilogram) of roasted coffee.

A coffee plant is usually six to eight years old before it bears a full crop of berries. The common variety of coffee plant grows best at altitudes that range from 3,600 to 8,000 feet (1,100 to 2,400 meters) in a tropical climate. The majority of coffee plants grow from seeds that are first planted in nursery beds. After a year in the nursery, the seedlings are transplanted to prepared fields. About 500 to 1,000 seedlings are planted per acre.

Preparation for market. Most berries are handpicked. However, some are harvested by machines that vibrate the berries off the trees. After the berries are picked, they are put through a bath of running water called a *sluice*. Sticks, leaves, and the green and bad berries float. The good berries sink to the bottom.

Pulping. The good berries then go to a pulping house, where machinery removes the pulp. Each berry contains two *beans* (seeds). Each bean has a thin parchmentlike skin, and a second covering called the *silver skin*. At first, the uncovered beans appear soft and bluish-green. Later, they become hard and pale yellow.

Following the pulping process, the beans are run through fermenting and washing tanks. The beans are then dried and left to cure for several weeks.

Hulling and peeling make up the next step in the preparation of coffee for the market. Milling machines remove the parchment and the silver skin. As the beans come from the machine, a fan blows off the loose skins. The beans then go to a machine called the *separator*, which removes sand, dust, and small or broken beans. The beans are sorted until only the largest and best of the coffee beans remain.

Roasting. Most coffee is shipped in 132-pound (60-kilogram) burlap bags. At the roasting plant, the beans are emptied into chutes leading from an upper to a lower floor. An air-suction device removes dust and other materials from the coffee. The coffee then goes to the blending machine, a cylinder that mixes different types of coffee.

From the blender, the beans flow by gravity to storage bins, then to roaster ovens. There, the beans are roasted at 900 °F (482 °C) for 16 to 17 minutes. The beans lose about a sixth of their weight during roasting. The beans are then cooled and cleaned, and carried to bins where they are stored until ground. After being ground to *drip, regular,* or *fine* requirements, the coffee is packed in vacuum tins or in paper bags.

Instant coffee can be either *powdered* or *freeze-dried*. Both require adding water to make coffee.

Powdered instant coffee is made by brewing coffee in huge containers and evaporating the water from the brew. The remaining powder crystals become coffee again when water is added.

Freeze-dried instant coffee is made by converting freshly brewed coffee into an extract and freezing it in slabs. The slabs are ground into chunks and put in pressurized chambers. Moisture in the form of ice is drawn off, leaving dry coffee crystals. See **Freeze-drying**.

A good cup of coffee. Best brewing results are obtained by using one standard coffee measure, or two level tablespoons, to each cup. The water should be freshly drawn from the cold-water tap. Most coffee is made in *percolators, drip* pots, or *vacuum* coffeemakers, which strain boiling water through the coffee.

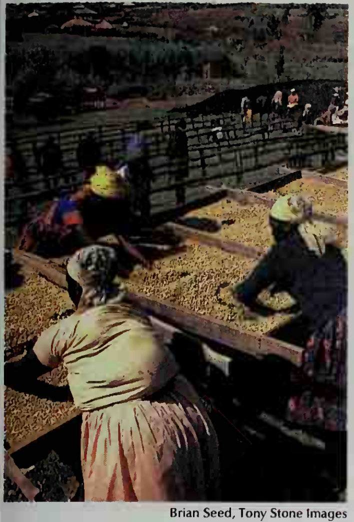
Kinds of coffee

Coffee producers sell more than 100 kinds of coffee. These kinds may be divided into three general groups—*Brazils, Milds,* and *Robustas*. The Milds include all *Coffea arabica* grown outside of Brazil. *Coffea robusta* is a different kind of coffee, most of which grows in Africa. Most coffee is named for the region where it grows or the port from which it is shipped. *Mocha* is named for

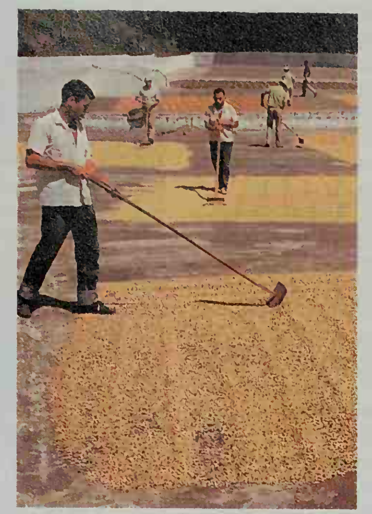


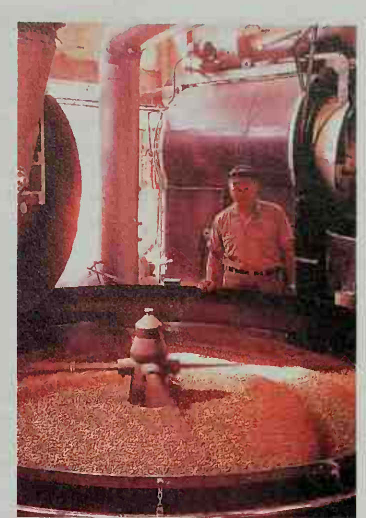
National Federation of Coffee Growers of Colombia

A worker picks coffee berries by hand. Most coffee berries are hand-picked. However, machines are sometimes used to vibrate the berries off the plants.



Brian Seed, Tony Stone Images


Elizabeth Harris, Tony Stone Images


Loren McIntyre, Woodfin Camp, Inc.

Preparing coffee for market. Workers spread and shake coffee beans to remove excess moisture, *left.* The beans are then dried in the sun, *center,* and left to cure for several weeks. After being shipped to a processing plant, the beans are roasted, *right,* to bring out their flavor.

the port of Mocha (Al Mukha) in Yemen. *Java* grows in and near Java, now part of Indonesia.

Roasters place great importance on the taste of their blends. Blends often include herbs and other additives. Chicory, for example, is an herb commonly added to coffee blends.

Coffee contains caffeine, a substance that acts as a stimulant on the nervous system (see **Caffeine**). Some people find *decaffeinated coffee* more healthful. In most cases, the removal of caffeine from coffee is a cold-water extraction, which is done with the help of chemicals.

History

According to legend, coffee was discovered in Ethiopia when goatherds noticed that their flocks stayed awake all night after feeding on coffee leaves and berries. Coffee reached Arabia in the 1200's. *Coffee* comes from the Arabic word *qahwah.*

Before its use as a beverage 700 years ago, coffee was a food, then a wine, and then a medicine. Coffee moved from Arabia to Turkey during the 1500's, and to Italy in the early 1600's. Coffee houses sprang up throughout Europe in the 1600's. People met there for serious discussions. Coffee probably came to America in the 1660's. Coffee growing was introduced in Brazil in the 1700's.

Coffee-exporting countries have tried for many years to control coffee prices and surpluses. At first, they agreed to export quotas that limited each country's exports. They also tried to control prices by stockpiling some coffee instead of exporting it. But in 1963, the United Nations helped arrange an International Coffee Agreement that included both exporting and importing countries. Countries that exported coffee accepted export quotas on coffee. Countries that imported coffee agreed to observe a floor on coffee prices and to limit their purchases of coffee from countries that did not sign the International Coffee Agreement.

Beginning in the late 1900's, large chains of coffee shops developed in the United States and other countries. These chains resemble fast-food restaurants and sell a variety of gourmet coffees. Jaime E. Lazarte

Scientific classification. Coffee belongs to the madder family, Rubiaceae. The common coffee plant is *Coffea arabica.*

Related articles in *World Book* include:

Brazil (picture)
Burundi (picture)
Chicory
Costa Rica (picture)
El Salvador (picture)
Ethiopia (picture)
Guatemala (picture)

Coffee house was a type of cafe that served as a center of business, cultural, and political life in Britain (now the United Kingdom). Coffee houses thrived from about 1650 to 1850. Londoners, especially, went to one or more coffee houses daily to learn the latest news. As newspapers developed, reporters also obtained information there. Some men kept regular hours at coffee houses, so that friends and clients knew when and where to find them. Many houses developed a group of customers who had similar business, cultural, political, or religious interests. For example, writers, merchants, and politicians gathered at different coffee houses.

In 1730, London had about 500 coffee houses. During the 1800's, they were gradually displaced by commercial institutions, private clubs, the home delivery of mail, and the growth of daily newspapers. J. C. D. Clark

Cofferdam is a temporary walled enclosure used in construction. It creates a space that protects workers and excavation sites from water and cave-ins. Cofferdams are used in building such structures as bridge piers, dams, and foundations. Simple cofferdams used in shallow water can be mounds of earth or sandbags. Cofferdams used in deeper water or deep excavations are usually made of interlocking steel sheets driven into the ground. Sometimes, they are made of closely spaced columns of wood, concrete, or metal. Such cofferdams must be braced to resist horizontal pressure from earth, water, and other sources. They may be made fairly watertight by packing clay behind the sheets or posts. William E. Saul

Coffin. See Funeral customs; Sarcophagus.

Coffin, Robert Peter Tristram (1892-1955), was an American author best known for his poems about Maine, his native state. Coffin won the 1936 Pulitzer Prize for poetry for his collection *Strange Holiness* (1935).

Coffin was born in Brunswick, Maine. Many of his writings describe the world of his childhood and youth in Maine. The central elements of his poetry are the sights and sounds of the Maine coast. In his later poetry, especially *People Behave Like Ballads* (1946), Coffin wrote about the rural people of Maine, whose endurance and good humor he valued highly. Coffin's verse is generally optimistic in tone.

Coffin also wrote novels, biographies, and criticism. His novel *Lost Paradise* (1934) re-creates his boyhood on a farm on the Maine seacoast. *Portrait of an American* (1931) is a biography of his father. Coffin's critical essays on poetry were published in *New Poetry of New England: Frost and Robinson* (1938) and *The Substance That Is Poetry* (1942). Elmer W. Borklund

Cohan, *koh HAN,* **George M.** (1878-1942), was a leading figure in the American theater during the early 1900's. Cohan wrote more than 40 plays and musicals, and he produced, directed, and starred in most of them. His shows were noted for their high spirits, dazzling showmanship, and distinctive American flavor.

Cohan's plays include *Broadway Jones* (1912), *Seven Keys to Baldpate* (1913), and *The Song-and-Dance Man* (1923). He wrote such musicals as *Little Johnny Jones* (1904), *Forty-Five Minutes from Broadway* (1906), and *George Washington, Jr.* (1906). Cohan's shows are seldom performed today, but several of his songs remain popular. They include "I'm a Yankee Doodle Dandy," "Give My Regards to Broadway," "You're a Grand Old Flag," "Mary's a Grand Old Name," and "Harrigan." Cohan also wrote "Over There," the most popular American patriotic song of World War I (1914-1918).

George Michael Cohan was born in Providence, Rhode Island. As a child, he performed with his parents and sister in a popular vaudeville act called "The Four Cohans." Cohan began to write songs and vaudeville sketches while a teen-ager. Frederick C. Wilkins

Cohen, *KOH uhn,* **Leonard** (1934-), is a Canadian poet and novelist. He has also won international fame as a songwriter and folk singer, setting his own poems to music. He has recorded many albums.

Most of Cohen's poetry is romantic, but his romanticism is often mixed with irony and dark cynicism. He prefers metrically regular forms. His central subjects are love, death, and spiritual vision. Cohen's first book of poetry was *Let Us Compare Mythologies* (1956). Other important poetic works include *The Spice-Box of Earth* (1961), *Flowers for Hitler* (1964), *The Energy of Slaves* (1972), and *Book of Mercy* (1984). *Selected Poems 1956-1968* (1968) is a good introduction to Cohen's poetry. He has written two novels. *The Favorite Game* (1963) follows the adventures of a young poet in Montreal. *Beautiful Losers* (1966) is a lyrical dream of Montreal, combined with Canadian religious history and the nature of sainthood. Leonard Norman Cohen was born in Montreal.

Laurie R. Ricou

Cohen, William Sebastian (1940-), was United States secretary of defense from 1997 to 2001, under President Bill Clinton. He was the first Republican nominated for that position by a Democratic president.

Cohen was born in Bangor, Maine. He received a bachelor's degree from Bowdoin College in 1962 and a law degree from Boston University in 1965. Cohen practiced law in Bangor from 1965 to 1972. In 1971, at the age of 31, he became the city's youngest mayor ever. He held the position until 1972.

From 1973 to 1979, Cohen served in the U.S. House of Representatives as a Republican from Maine. From 1979 to 1997, he represented Maine in the U.S. Senate. Cohen chaired the Senate Special Committee on Aging and served on committees on governmental affairs, intelligence, and the armed services. Although he had never served in the military, he became known in the Senate for his expertise on defense issues. Cohen has written several books, including nonfiction works, mystery novels, and poetry collections. Andrew Bennett

Cohesion, *koh HEE zhuhn,* is the force that holds a material together. It results from the attraction that atoms and molecules have for one another. This attraction decreases as the distance between particles increases. Thus, with few exceptions, cohesion is highest in solids. Liquids are less cohesive than solids, and gases are practically noncohesive. Powders can also exhibit cohesion, especially if they consist of fine particles packed together. Packed dirt, for example, can be a solid driving surface because of its cohesive properties.

Because of cohesion, effort is required to separate a material into two parts. This effort is called the *work of cohesion.* The work required to separate the material is twice its surface tension because two new surfaces have been created (see **Surface tension**).

Scientists can calculate the theoretical maximum stress a solid can withstand before breaking if they know the work of cohesion. This maximum is known as the solid's *tensile strength.* These calculated strengths are usually much higher than measured values. Scientists believe this is so because small surface cracks and other imperfections develop in solids and make them easier to break. Glass fibers, for example, have great resistance to breakage when first manufactured, but they develop fine cracks and lose strength rapidly. R. Hogg

See also **Adhesion; Molecule** (Molecules and matter).

Coin collecting is one of the most popular hobbies in the world. Most coin collectors simply enjoy trying to acquire a complete set of a nation's coins or of one or more particular coins. Some people collect coins as works of art. Others collect them as an investment, to be sold later at a profit. Through coins, a collector can also learn something about certain famous people and events in a country's history.

Imaginative coin collectors can build many types of collections. They can specialize in coins of one country or in various kinds of coins, such as cents or dollars. They can collect coins of unusual sizes or shapes. Many collectors concentrate on coins that illustrate a certain subject, such as animals, ships, or famous women.

The collecting or study of coins is called *numismatics,* and a coin collector is often called a *numismatist.* These words come from the Greek word *nomisma* and the Latin word *numisma,* both of which mean *a piece of money* or *a coin.* Numismatics includes paper money and also medals, tokens, and similar objects. This article tells how to begin and care for a coin collection.



WORLD BOOK photo

Many coin collectors mount their coins in albums. The collector above is using a magnifying glass to examine the details of a coin. She holds the coin by the edges to avoid staining it. Her coin catalog, *rear,* provides information about various coins.

Starting a coin collection. The best source of coins for a beginning collector is the change received when making various purchases. Friends also can help the beginning collector by letting him or her check the coins they may have—and swap money for any coins found that are not in the beginner's collection. Many beginning collectors go to a bank and exchange their money for rolls of coins. They then examine the rolls to find coins for their collection.

A coin's value depends on two factors—its condition and how easily it can be obtained. The most valuable coins are both *uncirculated* (unused) and scarce. A beginner should seek easily obtainable coins at first.

As collectors learn more and more about the hobby, they can start to acquire coins of greater value from several sources. For example, coin dealers and many collectors sell, trade, and buy coins. Some collectors obtain coins through auctions held in various communities or conducted by mail. In many countries, a government agency sells uncirculated coins to collectors.

A person should have some basic information about coin collecting before starting to acquire coins. Several books for beginners can be obtained at bookstores, hobby shops, and libraries.

Many collectors subscribe to a specialized newspaper, such as *Coin World* or *Numismatic News,* both of which are published weekly. The American Numismatic Association, the largest organization of coin collectors, publishes a monthly magazine, *The Numismatist,* with a section for young collectors. The association sponsors a program through the magazine that awards ancient coins to young people who complete certain numismatic activities. The magazine provides the names of U.S. coin clubs. These coin clubs encourage new collectors to attend their meetings and exhibitions.

Edward C. Rochette, the contributor of this article, is Former Executive President of the American Numismatic Association.

Collecting United States coins. Any person who collects U.S. coins should have *A Guide Book of United States Coins.* This book is called the Red Book because of its red cover. It gives the approximate price of any U.S. coin, depending on its condition and scarcity. A new edition is published annually.

The law requires U.S. coins to be dated with the year in which they are *struck* (made). The Department of the Treasury operates mints in Philadelphia; Denver; San Francisco; and West Point, N.Y. The Philadelphia and Denver mints make most coins for general circulation. The other two mints also make commemorative coins for special occasions. They also make gold and silver bullion coins that are purchased by people investing in the metal. At least some coins struck at each of these mints have a *mint mark.* All coins made at the Denver mint are stamped with a small *D,* and all coins except cents made at the Philadelphia mint receive a small *P.* Cents do not have mint marks. At the San Francisco and West Point mints, only commemorative coins and proof coins receive a mint mark. The San Francisco coins bear a small *S,* and those from West Point bear a small *W.* Bullion coins do not have mint marks.

Until 1965, dimes, quarters, and half dollars contained 90 per cent silver. Most collectors tried to assemble a complete set of these coins—as well as cents and nickels—by date and mint mark. In 1965, the government replaced silver dimes and quarters with coins made of nickel and copper. In 1971, the government made a similar change in the metal composition of half dollars. During the late 1960's, the price of silver rose rapidly. As a result, the value of the silver in a coin rose above the coin's face value. Millions of silver dimes, quarters, and half dollars were melted for their silver. Almost no silver coins remain in circulation.

Every year, the United States Mint strikes a limited number of cents, nickels, dimes, quarters, half dollars, and dollars for collectors. Many people buy a number of

The condition of coins

The condition of a coin plays an important part in determining its value. This table lists the grades used to describe a coin's condition, based on the amount of wear it has received. Coins are assigned numerical grades for greater accuracy in describing their condition.

Uncirculated coins are struck for general use but have never been circulated. The coins are graded for original luster, lack of scuff marks, and eye appeal. All values begin with the letters MS (Mint State). Grades range from MS-60 (low) to MS-70 (high).

About Uncirculated (AU) coins have been in circulation but show only traces of wear on the highest points of the design. Grades range from AU-50 to AU-59.

Extremely Fine (EF) coins show slight wear. Grades are either EF-40 or EF-45.

Very Fine (VF) coins show light to moderate wear on all parts of the design. Grades are either VF-20 or VF-30.

Fine (F) coins show moderate to considerable wear on all parts of the design. The grade given is F-12.

Very Good (VG) coins are well worn. The grade is VG-8.

Good (G) coins are heavily worn. Major features of the design are visible only in outline. The grade is G-4.

About Good (AG) coins are very heavily worn, with the date barely legible. These coins are seldom collected. The grade is AG-3.

Some rare and interesting coins Coin collectors prize coins that are rare or have some interesting feature. The Brasher doubloon is one of the rarest early American coins. The American commemorative half dollar honors the black educator Booker T. Washington. The Macedonian coin portrays Alexander the Great.

Coins of the United States


Brasher doubloon (1787)


Pine-tree shilling (1652)



Indian-head cent (1902)



Booker T. Washington commemorative half dollar (1950)

Coins of other countries


Macedonian tetradrachm (336 to 323 B.C.)


Roman denarius (A.D. 41 to 54)


Phoenician shekel (126 B.C. to A.D. 66)


Persian drachm (A.D. 590 to 627)


Frankish denier (A.D. 888 to 898)



Indian anna (1943)



Canadian dollar (1935)



Vatican 20-lire coin (1959)

WORLD BOOK photos by James Simek

sets of these special *proof* coins as an investment. Information on proof sets and other numismatic items may be obtained from the Customer Service Center, United States Mint, 10001 Aerospace Drive, Lanham, MD 20706.

Collecting coins of other countries offers an almost endless variety of opportunities. Some collectors try to acquire one coin from every country in the world. Other people build a collection of one-cent pieces from every country that issues such coins.

A reference book, *Standard Catalogue of Modern World Coins,* edited by Colin R. Bruce II, provides annually updated information about coins from other lands. Several other books deal with coins of specific countries and regions, such as Canada and Latin America.

Many nations sell their coins in uncirculated and proof condition to collectors. A few countries have taken advantage of the interest in coin collecting. They have issued coins with designs featuring subjects that have little in common with the country. Although the coins can be used as money, they do not circulate because they cost much more than their face value. These coins are called *Non-Circulating Legal Tender.*

Many collectors specialize in coins from ancient Greece, Rome, or Palestine. Various ancient coins, especially those of Greece, are prized for their beauty and craftsmanship. Some collectors specialize in coins that

were issued in Europe during the Middle Ages.

Caring for a coin collection. Coins should be protected from dust, fingerprints, and moisture, and from objects that could scratch them. A coin should be touched as little as possible. If one must be handled, it should be held by the edges and never put on the palm of the hand. Moisture from the skin can stain a coin.

Many stores sell albums in which to keep coins. Some collectors put their coins in metal cabinets that have trays lined with soft cloth. Others use small envelopes designed to hold coins.

Collectors should avoid cleaning their coins. Rubbing a coin to remove dirt or stains may increase the amount of wear on the metal and thus reduce the coin's value. A coin also may be scratched accidentally while being cleaned. Edward C. Rochette

For more information about coins, see the *World Book* article on **Money** and its list of *Related articles.*

Additional resources

Breen, Walter H. *Walter Breen's Complete Encyclopedia of U.S. and Colonial Coins.* Doubleday, 1988.
Cribb, Joe, and others. *The Coin Atlas: The World of Coinage from Its Origins to the Present Day.* Facts on File, 1990.
Krause, Barry. *Collecting Coins for Pleasure & Profit: A Comprehensive Guide and Handbook for Collectors and Investors.* Betterway Pubns., 1991.
Krause, Chester L., and Mishler, Clifford. *Standard Catalog of World Coins.* Krause. Published annually.

Coke is a hard, grayish substance obtained when soft coal is heated in an airtight coke oven. It is hard and *porous* (full of tiny holes), and, in most cases, contains 87 to 89 per cent carbon. Coke produces intense, smokeless heat when it burns.

Coke is made by heating *pulverized coal* (coal ground to a powder) in an airtight oven. As the coal heats, it *decomposes* (decays). It cannot burn completely without air. Coal tar and coke oven gas evaporate from the decomposed coal and are drawn out of the oven. The escaping tar and gas form the pores in the coke. The hot coke is taken out of the oven and cooled with water at a *quenching tower* to keep it from burning in the air.

Coke is valuable in *smelting* (melting) iron ore. Coke used in smelting is called *metallurgical coke.* In the United States, over 95 per cent of such coke is made in giant coking plants with *by-product ovens* equipped to save coal tar and coke oven gas. These ovens hold from 4 to 20 short tons (3.6 to 18 metric tons) or more of coal. If not properly sealed, by-product ovens can leak coal dust and harmful gases. Environmental concerns have led the coke industry to reduce leaks and to improve the operation and design of ovens. Joseph W. Leonard, III

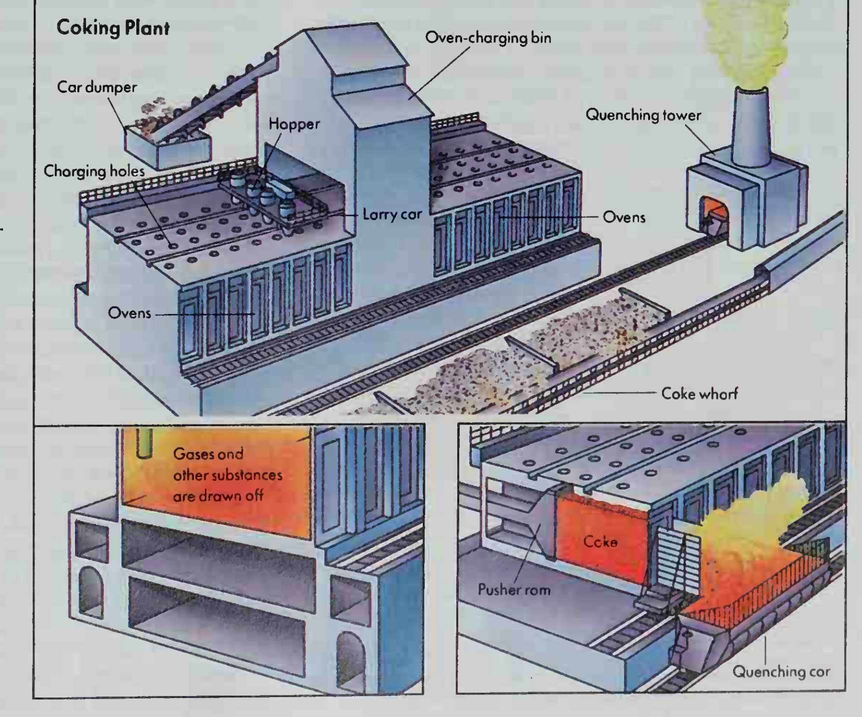
See also **Coal; Coke oven gas; Iron and steel** (Raw materials); **Petroleum coke.**

Coke oven gas, also called *coal gas,* is the gas obtained when coal is heated in an airtight place. It consists mainly of hydrogen and methane. Coke oven gas is burned to produce heat in industrial plants and in homes. It was formerly used for illumination. Coke oven gas is made by heating coal in a *by-product coke oven* that heats to about 2000 °F (1100 °C). As the coal heats, coke oven gas and other by-products are given off. The gas leaves the oven through pipes and is stored in large tanks called *gas holders.* See **Gas** (How gas is manufactured). Joseph W. Leonard, III

Cola di Rienzo, *KAW lah dee ree EHN zoh* (1313?-1354), was an Italian leader who turned from a freedom-loving reformer into a tyrant. His name is sometimes spelled *Rienzi.*

From coal to coke

Coal is converted to coke in the ovens of huge coking plants, *top.* Coal is transferred from a *car dumper* to the *oven-charging bin,* which feeds it into containers called *hoppers.* A *larry car* dumps the coal from the hoppers through *charging holes* into each oven. In the ovens, *lower left,* the coal is heated, and gases and other substances are drawn off. After 12 to 18 hours, all of the coal has been converted to coke. The oven is then opened, and the *pusher ram* shoves the coke into a *quenching car, lower right.* This car brings the coke to the *quenching tower, top,* where it is cooled with water. The coke is then dumped onto a *coke wharf* before being screened for size and shipped.



Adapted courtesy Eastern Gas and Fuel Associates; *Steelways,* American Iron and Steel Institute.

Cola was born in Rome, into a family with little money. He received a good education and became a *notary*—that is, a public official who wrote out contracts for others. He objected to the way the nobles oppressed the common people, and he dreamed of restoring the freedoms and glories of ancient Rome. In 1347, he called a meeting of the people to demand a new government. Soon he acquired the title of tribune and received the powers of a dictator. In ancient Rome, a *tribune* had been an official appointed as a defender of the people.

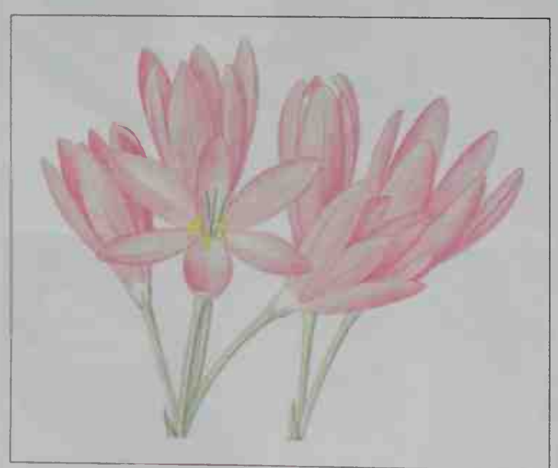
Cola ruled wisely at first. But he fought the nobles and then imposed taxes on the common people to support his troops and his increasingly lavish lifestyle. The people lost confidence in him, and Cola fled Rome after ruling for only seven months. He returned in 1354. The people welcomed him at first, and he regained power. But when he again began to rule tyrannically, the people rebelled and killed him. Paul F. Grendler

Cola nut. See Kola nut.

Colbert, *kawl BAIR,* **Jean Baptiste,** *zhahn bah TEEST* (1619-1683), a French statesman, served King Louis XIV as superintendent of finance from 1661 until his death. A believer in firm government control over the country's economy, Colbert worked to make France financially strong. He supported commerce, industries, and internal improvements such as canals and roads. He built a powerful navy and sent explorers and colonists to America. Colbert's efforts to keep the budget balanced failed when his rival the Marquis de Louvois, the war minister, persuaded Louis XIV to begin a costly series of wars. Colbert was born in Reims. *Colbertism* became another word for *mercantilism,* the most common European economic system of Colbert's day.

Donald A. Bailey

Colchicum, *KAHL chuh kuhm,* is a poisonous plant that grows wild in the moist meadowlands of England, Ireland, and of middle and southern Europe. It is sometimes called the meadow saffron. Its flowers range in color from purple to white and bloom in the autumn. Florists call the flowers, which look much like those of the crocus, *autumn crocus.* Colchicum is easily grown when planted in light, moist, sandy loam.



WORLD BOOK illustration by Christabel King

The colchicum is a poisonous European plant. Its flowers range in color from purple to white and bloom in the autumn.

Colchicine, a bitter drug taken from the colchicum plant, is used in small quantities to treat gout. Botanists use the drug in experiments in plant breeding. Colchicine causes the number of chromosomes in a plant cell to double, a condition known as *polyploidy.* Polyploid plants may be larger than the plants from which they were produced. Jerry M. Baskin

Scientific classification. The colchicum plant belongs to the lily family, Liliaceae. Its scientific name is *Colchicum autumnale.*

See also Crocus.

Cold. See Climate; Heat.

Cold, Common. The common cold results from any of a number of viral infections of the upper respiratory tract. It is the most widespread and common of all diseases. Although many people consider colds to be minor illnesses, colds are a major cause of absence from school and work. Every year in the United States, colds cost billions of dollars in lost working hours.

Common-cold infections vary in severity from a mild cold without fever to extensive, fatal pneumonia. Scientists have made great progress in identifying the more than 100 viruses that cause these illnesses. They have found that a reason people have so many colds is that different viruses can cause similar illnesses. Also, one cold virus does not give immunity against another.

People of all ages are susceptible to colds. But children—and adults living with children—seem to be most susceptible. Research has shown that colds cause about 100 million illnesses each year in Americans.

Symptoms. Colds are viral infections of the mucous membranes of the nose, throat, and, sometimes, of the air passages and lungs. A person with a cold usually has a stuffy nose and may have difficulty breathing. The infection may spread to the ears, sinuses, and eyes. In many cases, it spreads to the throat, causing soreness and hoarseness. When colds spread to the air passages and lungs, they may cause bronchitis and pneumonia.

The simplest kind of cold lasts a few days. More severe colds may last longer, often causing fever and aches and pains throughout the body. Occasionally, the patient also has chills and a loss of appetite.

Colds can be dangerous because they make people more susceptible to other infections, particularly bacterial infections of the ears, sinuses, and lungs. Colds are especially dangerous to the elderly and to people who have lung ailments or are weakened by poor health.

Treatment. Some studies suggest that taking a mineral called *zinc* as soon as symptoms begin may make colds shorter and less severe. Pain-relieving drugs may lessen muscle aches and pains. Nasal sprays and drops may be used for a limited time to shrink mucous membranes and make breathing easier. Vaporizers may also provide relief. A patient who has a fever should stay in bed. Staying in bed provides rest and isolates the patient from other people.

People with colds should eat nourishing foods and drink plenty of fluids, such as fruit juices, tea, or water. If the cold persists or seems to get worse, a doctor should be called. If complications begin to develop, the doctor can treat them early. Often the doctor prescribes antibiotics to control bacterial complications.

Spread. Experts do not know all the ways in which cold germs spread. But doctors believe that a person

can get a cold by breathing in the germs. Whenever a person with a cold coughs or sneezes, tiny droplets of moisture that contain cold germs spray out into the air. Thus, colds seem to spread most rapidly in places where many people gather together, such as in schools, offices, theaters, or buses. A person should always cover the mouth and nose when coughing or sneezing. Then the germs cannot spray into the air. Doctors also believe that cold germs can spread by direct contact, especially when the hands touch the mouth or nose.

Prevention. Colds are transmitted by people who have them. Therefore, isolating people who have colds is one of the best ways to prevent colds from spreading.

Although scientists have developed several vaccines for cold viruses, especially influenza virus, none has proved effective against all types of colds. However, influenza vaccines should be given to people who risk becoming seriously ill by getting a cold.

The cells of human beings produce chemicals called *interferons* that help fight some cold viruses. Scientists have found ways of obtaining interferons by laboratory processes. See **Interferon.** Neil R. Blacklow

See also **Cold sore; Echinacea.**

Cold-blooded animal is an animal that has little physiological control over its body temperature. Many cold-blooded animals, including most water animals, are warm when their surroundings are warm and cool when their surroundings are cool. Almost all animals are cold-blooded except birds and mammals, which are warm-blooded. See **Warm-blooded animal.**

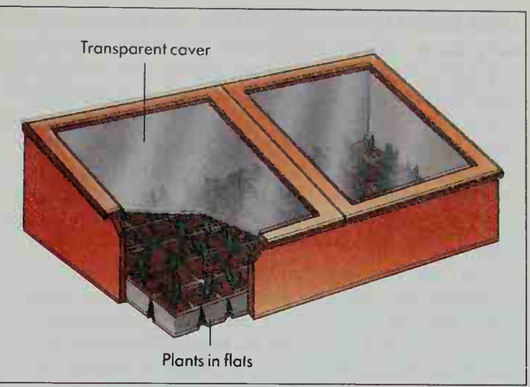
Some cold-blooded animals can control their body temperature to a certain extent by varying their activities. For example, the body of an active cecropia moth produces so much heat by muscular action that the animal becomes warmer than its surroundings. Most cold-blooded land animals adjust their temperature by moving to different surroundings—into sunlight when they become too cool and into shade when they become too warm. Scientists refer to cold-blooded animals as *ectothermic* or *poikilothermic.* James Edward Heath

Cold frame is a boxlike structure built or placed on the ground to protect plants during cold weather. Gardeners use cold frames in spring to shelter tender seedlings sprouted before the start of the growing season. Cold frames also extend the growing season of plants in fall by protecting them from frost.

A cold frame consists of a rectangular structure made of wood, concrete, or brick, with a cover of glass or transparent plastic. The cover lets in sunlight and retains heat. Most cold frames have a cover that slants downward toward the south, in order to let in as much sunlight as possible. On warm days, one side of the cover can be raised to cool the frame.

In most cases, gardeners plant seeds indoors in pots or in long boxes called *flats.* In the spring, they put the pots or flats containing the seedlings into cold frames. They may bury the pots to help the soil in the pots retain moisture. To prepare a growing area for seedlings planted directly inside a cold frame, a gardener replaces about 1 foot (30 centimeters) of soil with equal layers of gravel and richer soil.

In summer, plants that need shade can be protected from bright sunlight by replacing the transparent covering with wooden slats or burlap. A structure similar to a cold frame but heated by electric heat or other means is called a *hotbed* (see **Hotbed**). William H. Carlson



WORLD BOOK diagram by Paul D. Turnbaugh

A cold frame shelters plants outdoors. The transparent cover lets in sunlight and retains heat. The cold frame shown here holds *flats* (trays) of seedlings that were sprouted indoors.

Cold sore is a cluster of small blisters caused by a virus called *herpes simplex virus.* Cold sores can occur anywhere on the body. However, they appear mostly on the face, especially on or near the mouth. Cold sores are also called *fever blisters.* In many cases, they develop when a person has a cold or a fever.

In most cases, the herpes simplex virus that causes cold sores enters the body through the mouth or nose. The sores begin with itching, tingling, pain, and redness. Then the blisters appear. They soon break open, leaving yellowish crusts. The sores heal by themselves two to seven days after the blisters break open.

Many people suffer repeated attacks in which cold sores form in the same places. Most likely, these repeated attacks occur because the virus remains in the body after the sores heal. The dormant virus usually causes no symptoms, but certain conditions can reactivate it and produce new cold sores. These conditions include fever, overexposure to sunlight, emotional upset, and injury on the site of a previous sore.

A medicine sold under the name *Abreva* can help hinder cold sore outbreaks in some people. Doctors sometimes prescribe a drug called *acyclovir* for people with frequent cold sores. These drugs hinder outbreaks but do not cure the disorder. Charles J. McDonald

See also **Herpesvirus.**

Cold storage is a method of storing foods and other perishable products by holding them at low temperatures above freezing and in moist air. Low temperatures prevent spoilage by checking the growth of most harmful bacteria and slowing undesirable chemical reactions. Household refrigerators and commercial walk-in refrigerators used by grocers, butchers, restaurants, and warehouses generally keep food at 32 to 41 °F (0 to 5 °C). However, even at these temperatures, most fresh foods can only be preserved about one to four weeks. Furs are also kept in cold storage during the summer. Florists use cold storage to store flowers, plants, and bulbs. Pharmacists, physicians, and scientists use it to preserve drugs, serums, medicines, and specimens for research. See also **Cudahy, Michael; Food, Frozen; Refrigeration.**

Theodore P. Labuza

Cold War is the term used to describe the intense rivalry that developed after World War II between groups of Communist and non-Communist nations. On one side were the Union of Soviet Socialist Republics (U.S.S.R.) and its Communist allies, often referred to as the *Eastern bloc.* On the other side were the United States and its democratic allies, usually referred to as the *Western bloc.* The struggle was called the *Cold War* because it did not actually lead to fighting, or "hot" war, on a wide scale.

The Cold War was characterized by mutual distrust, suspicion, and misunderstandings by both the United States and the Soviet Union, and their allies. At times, these conditions increased the likelihood of a third world war. The United States accused the Soviet Union of seeking to expand Communism throughout the world. The Soviets, meanwhile, charged the United States with practicing imperialism and with attempting to stop revolutionary activity in other countries. Each bloc's vision of the world also contributed to East-West tension. The United States wanted a world of independent nations based on democratic principles. The Soviet Union, however, attempted to tightly control areas it considered vital to its national interest, including much of Eastern Europe. For a discussion of the principles of Communism and democracy, see **Communism** and **Democracy**.

Though the Cold War did not begin until the end of World War II, in 1945, relations between the United States and the Soviet Union had been strained since 1917. In that year, a revolution in Russia established a Communist dictatorship there. During the 1920's and the 1930's, the Soviets called for world revolution and the destruction of capitalism, which was the economic system of the United States. The United States did not grant diplomatic recognition to the Soviet Union until 1933.

In 1941, during World War II, Germany attacked the Soviet Union. The Soviet Union then joined the Western Allies in fighting Germany. For a time early in 1945, it seemed possible that a lasting friendship might develop between the United States and the Soviet Union based on their wartime cooperation. However, major differences continued to exist between the two, particularly with regard to Eastern Europe. As a result of these differences, the United States adopted a "get tough" policy toward the Soviet Union after the war ended. The Soviets responded by accusing the United States and the other *capitalist* allies of the West of seeking to encircle the Soviet Union so they could eventually overthrow its Communist form of government.

Two great blocs came into being. The United States led the Western bloc. By the early 1950's, this group included Britain, Canada, France, West Germany, Japan, the Philippines, and many other countries of Western Europe and Latin America. The Soviet Union led the Eastern bloc, which included Albania, Bulgaria, Czechoslovakia, East Germany, Hungary, Poland, and Romania. China joined the Eastern bloc following the Communist take-over of its government in 1949. The nonaligned or *neutral* nations—those in neither bloc—included India, Indonesia, Cambodia, and most of the African states.

During the late 1940's and the 1950's, the Cold War became increasingly tense. Each side accused the other of wanting to rule the world. Each side believed its political and economic systems were better than the other's. Each strengthened its armed forces. Both sides viewed the Cold War as a dispute between right and wrong. They saw every revolt and every international incident as part of the Cold War. This situation made it difficult to settle any dispute peacefully through compromise, with each side giving up something. Fear grew among all peoples that a local conflict would touch off a third world war that might destroy humanity.

The nature of the Cold War began to change in the 1960's. Neither the East nor the West remained a *monolith* (united bloc). Communist China challenged Soviet leadership. China accused the Soviet Union of betraying Communism and being secretly allied with the United States. Some Communist countries followed China's leadership, and others remained loyal to the U.S.S.R.

Among the nations of the Western bloc, France harshly criticized many U.S. policies and demanded independent leadership in Europe. West Germany also acted independently of U.S. policies. It searched for new economic and political relationships with other European countries, including East Germany.

Economic developments caused major shifts in the world balance of power during the 1960's. The rapid industrialization of Japan and West Germany made them important nations in the struggle for power. Their emergence and the growing strength of China led to new relationships. In 1970, Soviet and West German leaders signed a treaty pledging peaceful relations between their nations. The long-disputed status of West Berlin was settled in 1971 when Britain, France, the Soviet Union, and the United States agreed that the city was not part of West Germany. But the four powers also provided for economic and political ties between West Berlin and West Germany. Also in 1971, China joined the United Nations (UN). The United States established diplomatic relations with China in 1979.

Cold War tensions rose again after the Soviet Union invaded Afghanistan in 1979. Soviet leaders said the invasion was designed to help defend Afghanistan's pro-Communist government from Afghan rebels. In the late 1980's, however, Cold War tensions began to ease sharply after the signing of a major U.S.-Soviet arms-control agreement and after the U.S.S.R. removed its troops from Afghanistan.

Tensions further decreased after major democratic reforms took place in Eastern Europe. In 1991, the Soviet Union broke up into a number of independent, non-Communist states. These reforms and other developments marked the end of the Cold War.

The coming of the Cold War

Historians do not agree on exactly when the Cold War began. But most agree that the Yalta Conference, a meeting of Allied leaders in February 1945, marked the high point of wartime good will between the United States and the Soviet Union. Most historians also agree that relations between the two countries deteriorated noticeably within the first year after the conference.

Burton I. Kaufman, the contributor of this article, is Professor of History at Virginia Polytechnic Institute and State University.

The alliance breaks up. With Germany nearly defeated, the leaders of the Big Three nations met at the Yalta Conference to plan for the peace that would follow the war. These leaders were President Franklin D. Roosevelt of the United States, Prime Minister Winston Churchill of the United Kingdom, and Premier Joseph Stalin of the Soviet Union. At Yalta, the leaders agreed to set up *occupation zones* (areas controlled by the Allies) for postwar Germany and made plans to form the United Nations. In addition, Stalin promised that the U.S.S.R. would go to war against Japan within three months after Germany surrendered. See **Yalta Conference.**

The Allied leaders also developed the Declaration on Liberated Europe, in which they pledged to hold democratic elections in countries freed from the control of Germany and its allies. The Soviet Union failed, however, to keep this agreement. At the time it was made, Soviet forces had driven German troops out of most of Eastern Europe and had established a pro-Communist government in Poland. In spite of the Declaration on Liberated Europe, Stalin was determined to maintain tight control over Eastern Europe. He especially felt that control of Poland, which had been used as a route to invade the Soviet Union, was necessary to Soviet security. The United States felt betrayed by Stalin's refusal to carry out all of his promises and by his determination to establish a "sphere of influence" in Eastern Europe.

Roosevelt died in April 1945 and was succeeded as president by Harry S. Truman. Germany surrendered in May 1945. The main Allied leaders met for the final time at Potsdam, near Berlin, in July 1945. Just before the meeting, Churchill's Conservative Party was defeated in an election. Clement R. Attlee succeeded Churchill during the Potsdam Conference.

At Potsdam, the Allies agreed that the German people should be allowed to rebuild their lives "on a democratic and peaceful basis." However, serious disagreements arose. The United Kingdom and the United States charged that the U.S.S.R. was communizing the countries of Eastern Europe. Even before World War II ended, the U.S.S.R. had taken over the Baltic states of Latvia, Estonia, and Lithuania; parts of Poland, Finland, and Romania; and eastern Czechoslovakia. Soviet troops occupied a third of Germany and all of Bulgaria, Hungary, Poland, and Romania. Nevertheless, the Western nations reluctantly agreed to a Soviet-backed transfer of 40,000 square miles (100,000 square kilometers) of German territory to Polish control. See **Potsdam Conference.**

The Iron Curtain descends. During 1945 and early in 1946, the Soviet Union cut off nearly all contacts between the West and the occupied territories of Eastern Europe. In March 1946, Churchill warned that "an iron curtain has descended across the Continent" of Europe. He made popular the phrase *Iron Curtain* to refer to Soviet barriers against the West. Behind these barriers, the U.S.S.R. steadily expanded its power.

In 1946, the U.S.S.R. organized Communist governments in Bulgaria and Romania. In 1947, Communists took control of Hungary and Poland. Communists seized full power in Czechoslovakia early in 1948. These countries became Soviet *satellites* (nations controlled by the U.S.S.R.).

Albania already had turned to Communism. Enver Hoxha, who led the Communist National Liberation Army in an Albanian civil war during World War II, established a Communist government in 1944.

Yugoslavia also joined the Communist bloc. The Communist Party of Yugoslavia had helped drive out the Germans near the end of the war. Communists led by Josip Broz Tito then took over the government.

East and West opposed each other in the United Nations. In 1946, the U.S.S.R. rejected a U.S. proposal for an international agency to control nuclear energy production and research. The Soviet Union believed the United States had a lead in nuclear weapons and would have a monopoly if controls were approved. The Soviet Union pictured itself as a defender of peace and accused the United States of planning a third world war.

See the *History* section of the articles on each Communist country mentioned in this section.

The West holds the line

The Containment Policy. In the fall of 1946, Greek Communists revolted against the Greek government. The United Kingdom had been giving military and economic aid to Greece. But the British told the United States they could no longer give enough help to the Greeks. The British also warned that they could not help Turkey resist Communist pressure.

In March 1947, President Truman declared that the United States would help any free nation resist Communist *aggression* (attack). Congress granted his request for $400 million for aid to Greece and Turkey. With this aid, both Greece and Turkey successfully resisted Communism. The new American policy became known as the *Truman Doctrine.* Aimed at Soviet expansion in Europe and the Middle East, the Truman Doctrine developed into the *Containment Policy.* The Containment Policy was designed to *contain* (hold back) the expansion of Communism throughout the world.

The foreign ministers of the United States, the United Kingdom, France, and the Soviet Union met in Moscow in March and April 1947. They tried to draw up a German peace treaty. But the ministers could not agree on how to end the occupation or how to unify Germany.

The failure of the conference convinced U.S. Secretary of State George C. Marshall that the U.S.S.R. would not help Europe recover from World War II. In June 1947, Marshall proposed giving U.S. economic aid to all European nations that would cooperate in plans for their own recovery. This proposal grew into the European Recovery Program, or Marshall Plan, which began in 1948. The United States believed that a strong, stable Western Europe would block the spread of Communism. Meanwhile, in September 1947, the U.S.S.R. and eight other European Communist parties set up the *Cominform,* a new version of the Communist International. See **Marshall Plan.**

Czechoslovakia and Poland wanted to take part in the Marshall Plan, but the U.S.S.R. would not let them accept U.S. aid. Instead, the Soviet Union set up the Council for Mutual Economic Assistance (COMECON) in January 1949. This organization was designed to unite the East European satellites economically and politically.

In June 1948, the Western Allies announced plans to unify their German occupation zones and establish the West German Federal Republic (West Germany). West Germany was formally established in September 1949. It

had independence in some of its internal affairs, and it joined the Marshall Plan.

Also in June 1948, the U.S.S.R. harshly criticized Tito, the Communist leader of Yugoslavia. Tito then declared his country's independence from Soviet control.

The Berlin blockade was the Soviet answer to the West's plans for West Germany. In June 1948, Soviet troops blocked all railroad, highway, and water traffic through East Germany to West Berlin. The city lay 110 miles (177 kilometers) inside the Soviet occupation zone. The Soviet leaders thought their blockade would force the West to leave Berlin. Instead of pulling out of West Berlin, the Americans, British, and French set up the *Berlin airlift.* For 11 months, West Berlin was supplied with food and fuel entirely by airplanes. The U.S.S.R. lifted the blockade in May 1949. The Allies ended the airlift in September.

The West rearms. Military strength became more and more important in the late 1940's. During the Berlin blockade, the United States pledged continuing military aid to Western Europe. The United States, Canada, and 10 Western European nations signed the North Atlantic Treaty in April 1949. This mutual defense treaty set up the North Atlantic Treaty Organization (NATO), a military alliance (see **North Atlantic Treaty Organization**). The goals of the alliance included the prevention of Soviet expansion and the defense of West Germany. In September 1951, the United States signed the ANZUS mutual defense treaty with Australia and New Zealand.

The nuclear arms race began on Aug. 29, 1949, when the Soviet Union tested an atomic bomb. Until then, the United States had been the only nation that knew how to make the atomic bomb.

Communist expansion in Asia. During the 1940's, Communist strength increased in the Far East. The U.S.S.R. had occupied Manchuria just before the end of World War II. After they left in 1946, the Chinese Communists took over most of northern Manchuria. The U.S.S.R. also set up a North Korean "people's republic."

In China, Mao Zedong's Communist troops fought the Nationalist armies of Chiang Kai-shek. The United States gave military aid to Chiang. Late in 1949, Chiang and his government fled to the island of Taiwan, near the mainland of China. The conquest of China by Mao's forces put China into the Communist bloc.

The Korean War. At the end of World War II, Soviet troops occupied North Korea and U.S. forces occupied South Korea. The North Koreans had a strong army. They got Soviet military aid even after Soviet troops withdrew from North Korea late in 1948. The United States withdrew its forces from South Korea in June 1949.

North Korean troops invaded South Korea on June 25, 1950, and the Korean War began. On June 27, President Truman sent U.S. forces to aid the South Koreans. At the request of the United States, the United Nations Security Council voted to send UN troops to help South Korea. The Soviet delegation was *boycotting* (not attending) the council, and missed a chance to veto the decision. Seventeen nations contributed men to the UN force, and Chinese Communist troops aided the North Koreans.

Peace talks began in July 1951. They went on for two years while bloody fighting continued. Finally, in July 1953, representatives of the UN and the Communists signed an armistice. In 1954, representatives of both sides met in Geneva, Switzerland, to discuss a political settlement. But they could not agree on a way to unite North and South Korea.

The Korean War was the first war in which troops of a world organization fought an aggressor nation. For the first time, Americans fought a "hot war" against Communism. Some historians believe the Korean War was a major turning point in the Cold War. It extended the Containment Policy to the Far East. It also introduced limited warfare to the East-West conflict as a substitute to all-out—and possibly nuclear—war. Each side avoided attacking targets that could have led to expansion of the war. And each side limited the weapons it used and the territory in which it would fight. See **Korean War**.

To the brink and back

The death of Stalin changed the character of the Cold War. The Soviet leader died in March 1953, two months after Dwight D. Eisenhower became President of the United States. The new Soviet rulers governed as a committee at first. Premier Georgi M. Malenkov and his associates adopted a softer policy toward the Soviet satellites and the West. For example, they allowed the Soviet wives of U.S. servicemen to follow their husbands to America. The U.S.S.R. also set up a cultural exchange program with the West. Soviet troops put down a revolt in East Germany in June 1953, but the Soviet Union's softer course of action was obvious.

The arms race continued. The United States tested its first hydrogen bomb in November 1952, and the U.S.S.R. set off its first H-bomb in November 1955. Military alliances were strengthened during this period. Also in 1955, West Germany joined NATO. In response, the U.S.S.R. and its Eastern European satellites signed the Warsaw Mutual Defense Pact, a military alliance. In 1955, the United States announced its support of the military alliance of the Baghdad Pact, which later became the Central Treaty Organization. See **Warsaw Pact**.

In January 1954, the new U.S. secretary of state, John Foster Dulles, had outlined a new American military policy. The United States, he warned, would meet Communist aggression by "massive retaliation" with nuclear weapons. The United States, Dulles said, would strike back "at places and with means of our own choosing."

Cold War tensions increased in eastern Asia during 1954 and 1955. The nationalist Vietnamese in Indochina were led by Communists and supported by China. In the spring of 1954, after years of fighting, they defeated the French at Dien Bien Phu. A cease-fire agreement was signed in Geneva in July 1954. It recognized the temporary division of Vietnam and gave North Vietnam to the Communists. Nationwide elections were to be held in 1956. However, neither the United States nor South Vietnam signed the agreement, and South Vietnam refused to hold the elections. The agreement also established the independence of Cambodia, Laos, and South Vietnam.

In September 1954, the United States and seven other nations signed the Southeast Asia Collective Defense Treaty (see **Southeast Asia Treaty Organization**). This treaty was designed to prevent further Communist expansion in Southeast Asia. After the defeat of France in Indochina, the United States increased its aid to South Vietnam. The United States believed that if one South-

east Asian nation fell to Communism, the others would also topple over, one after another. This was called the "domino theory." But even with U.S. support, South Vietnam could not defeat the Communist rebels. The rebels, called Viet Cong, were supported by North Vietnam. In 1955, the United States began sending military advisers to help the South Vietnamese government.

The United States also increased its support of the Chinese Nationalists on Taiwan. In September 1954, the Chinese Communists staged air and artillery attacks against the islands of Quemoy and Matsu. These islands, in the Formosa Strait, were held by the Nationalist Chinese. In 1955, Congress voted to let President Eisenhower use armed force if necessary to protect the Chinese Nationalists.

The spirit of Geneva. In Europe, a thaw in the Cold War became apparent in 1955. The Western Allies and the U.S.S.R. signed a peace treaty with Austria in May. Soviet troops left that country, and Austria became an independent, neutral nation. That same month, Nikita S. Khrushchev, the Soviet Communist Party chief, apologized to Tito and resumed trade with Yugoslavia.

Eisenhower and Khrushchev met in Geneva in July. Both leaders agreed that a nuclear war would be a disaster for both sides. Political observers began to write of a "big thaw" in East-West relations and called it the "spirit of Geneva." After the Geneva conference, the U.S.S.R. announced a cut of 640,000 men in its armed forces. The Soviet Union said it also had reduced the armies of its satellites.

Dulles still distrusted the Soviet Union in spite of its softer line. In January 1956, he told the American people that the United States had been on the brink of war several times. "If you are scared to go to the brink, you are lost," Dulles warned. The use of "brinkmanship" had become part of U.S. policy.

In February 1956, Khrushchev called for *peaceful coexistence* (competition without war) between East and West. He also began a campaign of *destalinization* (removal of Stalinist influences) in the U.S.S.R. and its satellites. In April 1956, the U.S.S.R. dissolved the Cominform.

Unrest in Eastern Europe. The new Soviet policy encouraged the peoples of Eastern Europe to expect more freedom from Soviet rule. In Poland, riots and strikes broke out in Poznań in June 1956, and spread to other cities. The rioters demanded a more liberal government and an end to Soviet rule. A few months later, the U.S.S.R. allowed Władysław Gomułka, a Polish Communist leader, to rejoin the Polish Communist Party. The U.S.S.R. had jailed Gomułka in 1951 for trying to set up an independent Communist government in Poland. Khrushchev and other Soviet leaders flew to Warsaw to confer with Gomułka in October 1956. Faced with further rebellion, the U.S.S.R. agreed to relax some controls in Poland. See **Poland** (Communist rule).

In Hungary, a revolt against Communism began in October 1956. A rebel government led by Imre Nagy demanded withdrawal of all Soviet troops. Early in November, Soviet tanks rolled into Budapest. The fighting spread to all parts of the country, and thousands of Hungarian "freedom fighters" were killed. The Soviet Union smashed the revolt in about two weeks. In spite of the new Soviet policy, the Soviet Union could not allow Hungary to break up the bloc of Eastern European satellites. See **Hungary** (Communist Hungary).

Trouble at Suez. During the period that the U.S.S.R. was putting down unrest in its Eastern European satellites, trouble was stirring in the Middle East. The United States feared Communist expansion in that area. Both the U.S.S.R. and the West sought Egypt's support by offering aid for its development plans. Each side offered to help build the Aswan High Dam. After Egypt courted Communist aid for the dam and bought Communist arms, the United States and Great Britain canceled offers to help with the project. President Gamal Abdel Nasser of Egypt struck back by seizing the Suez Canal from international control. He said Egypt would use profits from operating the canal to build the dam "without pressure from any nation." But he did accept Soviet aid.

In October 1956, while the U.S.S.R. was involved with the Hungarian revolt, Israel invaded Egypt. Britain and France immediately joined in the attack. They wanted to return the Suez Canal to international control. The United States and the U.S.S.R. supported a United Nations resolution demanding an immediate truce. In addition, the U.S.S.R. threatened to send troops to help Egypt. The UN arranged a truce after a few days of fighting. But the U.S.S.R., by backing Egypt against Israel, had won friends among the Arab nations of the Middle East.

New challenges

Khrushchev's power in the Soviet Union reached its peak in the late 1950's. Sometimes the U.S.S.R. followed a hard policy, mainly in response to China's challenge to Soviet leadership of the Communist bloc. At other times, the U.S.S.R. stressed peaceful coexistence, giving special attention to economic aid and scientific progress. But the Soviet Union continued to encourage "wars of liberation." As a result, the United States came to regard "peaceful coexistence" as the Communist effort to conquer countries without a major war.

The missile gap. The U.S.S.R. improved its ability to produce nuclear weapons, and the Western bloc feared a missile gap, or Soviet rocket superiority. In June 1957, the U.S.S.R. successfully tested an intercontinental ballistic missile (ICBM). That same year, the U.S.S.R. launched the first artificial earth satellite, *Sputnik 1.* In January 1958, the United States launched its first earth satellite. Soviet rocket power was more advanced, but the two powers had clearly established a nuclear "balance of terror." A brief thaw in the Cold War followed. The U.S.S.R. stopped testing nuclear weapons in March 1958, and the United States halted its tests in October.

The Eisenhower Doctrine was approved by Congress in March 1957 because the United States feared Communist penetration in the Middle East. This policy permitted the President to "use armed force to assist any . . . nation . . . [in the Middle East] requesting assistance against armed aggression from any country controlled by international Communism."

In July 1958, a revolution ended the rule of the pro-Western government of Iraq. Nearby Lebanon feared a Communist revolution and asked the United States for aid. Eisenhower quickly sent about 6,000 sailors and marines to help Lebanon. Great Britain sent paratroopers to protect Jordan against Iraqi pressure. In spite of Soviet protests, the American and British forces stayed in the Middle East for about three months.

The Far East. In 1958, the Chinese Communists again fired on Quemoy and Matsu, Taiwan's offshore islands. Dulles warned that any attack on these islands would be considered aggression against Nationalist China, a U.S. ally. But occasional firing continued during the 1960's.

Germany. During the late 1950's, Europe remained the most important Cold War battleground. The U.S.S.R. tried repeatedly to damage the reputation of the West in Germany. In November 1958, the U.S.S.R. demanded peace treaties for East and West Germany. Such treaties would have ended the military occupation, and Western troops would have had to leave. The United States refused to yield to the demand, and kept its forces in Berlin. As a result, the U.S.S.R. kept threatening to sign a separate peace treaty with East Germany.

The spirit of Camp David. Another temporary thaw in the Cold War began in the spring of 1959. The foreign ministers of the United States, Great Britain, France, and the U.S.S.R. met in May. In July, Vice President Richard M. Nixon visited the U.S.S.R. and met with Khrushchev. Two months later, Khrushchev visited the United States. He conferred with Eisenhower at Camp David in Maryland. Khrushchev was so friendly that observers spoke of the "spirit of Camp David," recalling the earlier "spirit of Geneva." Eisenhower and Khrushchev discussed a *summit* (top-level) conference to be held in Paris in 1960. The President accepted Khrushchev's invitation to visit the Soviet Union after the summit meeting.

The U-2 incident abruptly ended the thaw. An American U-2 spy plane was shot down in the U.S.S.R. in May 1960. The Soviet Union captured the pilot, Francis Gary Powers, who confessed he was a spy. Eisenhower accepted personal responsibility for the flight. He admitted that U-2 planes had been flying over the U.S.S.R. taking photographs for four years.

When the summit conference began on May 15, Khrushchev demanded that Eisenhower apologize for the U-2 incident. Eisenhower refused, and Khrushchev angrily canceled his invitation for the President to visit the U.S.S.R.

Africa. The Cold War struggle moved to Africa in July 1960. Premier Patrice Lumumba of the Congo asked the UN to deal with a revolt in his newly independent nation. He charged that the Belgians were aiding the rebel Katangans. The U.S.S.R. sided with Lumumba against a group led by Congolese President Joseph Kasavubu. The UN intervened in the dispute, keeping the U.S.S.R. and the West from direct military action. The Soviet Union charged that the UN favored the West.

The troika proposal. In September 1960, Khrushchev went to New York City for the meeting of the UN General Assembly. He again criticized the United States for the U-2 flights. The Soviet leader showed his anger by taking off a shoe and pounding his desk with it.

Khrushchev tried to destroy the power of the UN to send troops into trouble spots. He called for three secretaries-general—a *troika* (a Russian term for a vehicle drawn by three horses)—to replace the UN secretary-general. One of the secretaries-general would be a Communist, one from a neutral nation, and one from the West. The General Assembly defeated the proposal.

The Bay of Pigs. John F. Kennedy became President of the United States in January 1961. Cold War tensions were high—in Europe, in Asia, and even on the doorstep of the United States, in Cuba.

The Cuban government of Fidel Castro had become openly Communist in 1960. Castro condemned the United States and began to receive military aid from the Soviet Union and other Communist countries. The Cuban government seized millions of dollars' worth of American property in Cuba. The United States ended diplomatic relations with Cuba in January 1961.

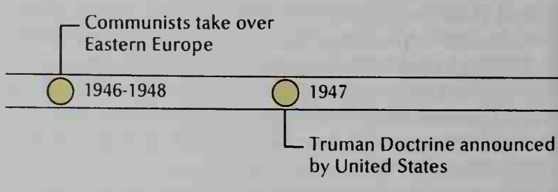
In April 1961, the United States sponsored an invasion of Cuba by anti-Castro Cubans at the Bay of Pigs. The attack was poorly planned and failed badly. The unsuccessful invasion strengthened Castro's control of Cuba,

Highlights of the Cold War

Winston Churchill warned in a famous 1946 speech that an "Iron Curtain" had come down across Europe. U.S. President Harry S. Truman introduced the former British prime minister to an audience at Westminster College in Fulton, Mo.

Winston Churchill Memorial and Library in the U.S.







United Press Int.

The Greek Civil War ended in defeat for the Communist rebels. U.S. aid sent under the Truman Doctrine aided the victors.

and it caused the United States to lose face.

The Berlin Wall. Kennedy and Khrushchev met in Vienna, Austria, in June 1961. Khrushchev demanded a free Berlin and an end of the military occupation. The two leaders failed to reach agreement, and Khrushchev again threatened to sign a separate peace treaty with East Germany. In July 1961, the U.S.S.R. canceled cuts in its armed forces and increased military spending.

Growing numbers of East Germans were fleeing to West Germany. On Aug. 13, 1961, the East German Communists began to build a wall of cement and barbed wire between East and West Berlin. To confirm the right of the Western powers to remain in West Berlin, the United States sent troops to the city by highway. U.S. tanks enforced Western rights to enter East Berlin without showing papers to Communist border guards. Some East Germans escaped to West Berlin after the wall was built, but many were killed in the attempt. See **Berlin Wall.**

The space race begins. On Oct. 4, 1957, the Soviet Union launched Sputnik 1, the first artificial satellite. Several months later, on Jan. 31, 1958, the United States launched its first satellite, Explorer 1. In 1961, the two countries each launched their first manned spacecraft.

In September 1961, the U.S.S.R. ignored an unofficial agreement against nuclear weapons tests, and resumed nuclear bomb testing in the atmosphere. The United States then resumed underground testing. American tests above ground were started again in April 1962.

The Cuban missile crisis. In October 1962, the United States learned that the U.S.S.R. had secretly installed missiles and missile bases in Cuba, about 90 miles (140 kilometers) from Florida. President Kennedy demanded that the U.S.S.R. remove them. He set up naval "quarantine" of Cuba. The U.S.S.R. said that it would not remove the missiles unless the United States removed its nuclear missiles from Turkey. Kennedy privately agreed to the proposal. After a week of extreme tension, Khrushchev removed the Soviet missiles. See **Cuban missile crisis.**

Easing Cold War tensions

After the missile crisis in Cuba, Cold War tensions again eased. In July 1963, the United States, the U.S.S.R., and Britain approved a treaty to stop the testing of nuclear weapons in the atmosphere, in outer space, and under water. In August, the United States and the U.S.S.R. set up a *hot line* between the White House and the Kremlin. This direct communications link was installed to reduce the risk of accidental nuclear war.

In 1963, the U.S.S.R. faced a serious shortage of grain. Kennedy approved a plan to sell the U.S.S.R. $250 million worth of American wheat. That same year, the two nations agreed to cooperate in space projects using weather and communications satellites.

President Lyndon B. Johnson, who became Chief Executive after Kennedy was assassinated in November 1963, continued to work for peaceful coexistence. In 1964, the United States and the U.S.S.R. signed their first *bilateral* (two-nation) treaty. It provided that a *consul* (representative) of each nation would have an office in a city of the other country. It also provided protection for Americans traveling in the U.S.S.R. and for Soviet citizens traveling in the United States. The U.S. Senate approved the treaty in 1967, and the U.S.S.R. approved it in 1968. The two nations also extended an agreement for educational, scientific, and cultural exchanges.

The shifting Cold War battleground

The character of the Cold War changed again in the mid-1960's. The United States and the U.S.S.R. each had large numbers of nuclear weapons. Each had an antimissile defense system. But both powers realized that there would be no victor in an all-out nuclear war. Also, conflicts within both the Eastern and Western blocs changed the two-sided nature of the balance of power.

1948-1949 — Berlin blockade set up by Soviet Union

1949 — NATO pact signed by 12 countries

1949 — Communists win control of China

1950-1953 — Korean War—first use of UN troops in battle



United Press Int.

The Berlin airlift of 1948-1949 defeated an attempt by the Soviet Union to force the Western Allies out of West Berlin.



Wide World

The Korean War ended in 1953 with an armistice. Fighting had continued during two years of peace talks.

The great blocs split. Following the Soviet Union's destalinization campaign, the U.S.S.R. and Communist China began to move along different paths. In 1960, at the third Congress of the Romanian Communist Party, the U.S.S.R. and China quarreled bitterly and openly. The Soviet Union soon cut off technical aid to China. When China attacked India in 1962, the U.S.S.R. supported India. The Soviet Union again backed India when Pakistan and India fought in 1965. China threatened India and aided Pakistan.

Khrushchev fell from power in October 1964. The new Soviet leaders tried to heal the split with China. But Premier Aleksei N. Kosygin and General Secretary Leonid I. Brezhnev were unable to reunite the Communist bloc.

In 1966, China launched a "cultural revolution." One aim of this revolution was to eliminate all Soviet influence from China. The Chinese accused the Soviet Union of betraying world Communism and being secret allies of the United States. The Chinese threat to the Soviet Union became more real when China exploded its first hydrogen bomb in June 1967.

In March 1969, Soviet and Chinese troops began to fight each other on an island in the frozen Ussuri River. This river is the border between Chinese Manchuria and the Soviet Union's maritime territories. Both countries claimed they owned the island. The fighting soon ended, but the border controversy remained unsettled.

Some of the Soviet Union's satellites also shifted their loyalty. Albania had sided with China in 1961, and neither China nor Albania attended the 23rd Communist Party Congress in Moscow in 1965. Yugoslavia remained independent, with its own brand of "national Communism." Other Communist nations, including Romania, Poland, and Cuba, loosened their ties with the U.S.S.R.

Differences also sharpened among the Western nations. President Charles de Gaulle of France challenged the leadership of the United States and Great Britain. France established diplomatic relations with China in 1964, and sharply criticized U.S. policy in the Vietnam War. At de Gaulle's request, NATO moved its military headquarters from France in 1967, and the French withdrew their troops from the alliance. France also blocked Great Britain's entry into the European Economic Community (EEC). In 1967, de Gaulle further strengthened France's relations with the U.S.S.R. and Eastern Europe. In June of that year, France sided with the Arabs against Israel in the Arab-Israeli War. In 1968, France exploded a hydrogen bomb.

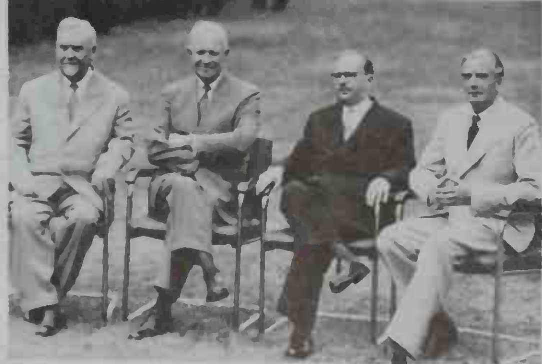
The growing strength of Europe was another factor in the changing nature of the Cold War. More than 20 years after the end of World War II, the nations of Western Europe were enjoying prosperity. The EEC, also called the European Common Market, had become a powerful economic force. Western European nations gradually increased trade with Communist countries. Many Western European leaders worried more about Germany's return to power than about the U.S.S.R.

Soviet-American relations in the 1960's reflected the changing nature of the Cold War. In 1966, the U.S.S.R. and the United States agreed to permit direct air service between Moscow and New York City. By January 1967, they and 60 other nations had signed the first international treaty providing for the peaceful exploration and use of outer space.

President Johnson and Premier Kosygin met for the first time in June 1967. Kosygin went to the United States to address the UN General Assembly. The two leaders met in Glassboro, N.J., and discussed the Vietnam War, the Arab-Israeli dispute, and disarmament.

In August 1967, the U.S.S.R. and the United States submitted proposals at the Geneva Disarmament Conference for a treaty to prevent the spread of nuclear weapons. In 1968, they agreed on an addition to the treaty providing for international inspection and controls. France refused to sign the treaty. The U.S. Senate approved it in 1969. The treaty, called the Treaty on the

1953 — Death of Stalin alters Cold War
1955 — Summit conference held in Geneva
1960 — Soviet Union downs U-2 spy plane
1961 — German Communists build Berlin Wall



United Press Int.

At Geneva, U.S. President Dwight D. Eisenhower, *second from left,* met with Soviet, French, and British leaders.



John Bryson, Rapho Guillumette

A U.S. spy plane was shot down over the U.S.S.R. in 1960, and the U.S.S.R. canceled a summit meeting with the United States.

Non-Proliferation of Nuclear Weapons, went into effect on March 5, 1970, after being *ratified* (formally approved) by the United States, the U.S.S.R., Britain, and more than 40 other nations. Since then, over 100 additional nations have ratified it.

In 1969, Soviet and U.S. representatives began a series of Strategic Arms Limitation Talks (SALT). The representatives worked toward an agreement to control the production of nuclear weapons.

The invasion of Czechoslovakia. Hopes for an easing of Cold War tensions in Europe were jolted in August 1968, when Soviet, Bulgarian, East German, Hungarian, and Polish troops invaded Czechoslovakia. The invasion halted a move by Czechoslovakia to give more individual freedom to the its people. In October, Czechoslovakia and the U.S.S.R. signed a treaty that allowed Soviet troops to remain and assured that Czechoslovakia would continue as a Soviet satellite.

The battle for the neutral nations continued in the 1960's. In Latin America, the United States still guarded against the threat of Communism. In April and May 1965, the United States, at the request of the Dominican Republic, sent troops to the Dominican Republic to prevent a Communist take-over during a revolt there. The crisis eased, and the United States troops left.

In the Middle East, a six-day war broke out between Israel and the Arab powers in June 1967. The United States backed the Israelis. The U.S.S.R. helped arm the Arabs before the war began, but this did not prevent their defeat. Scattered fighting continued in the area during the late 1960's. The United States and the U.S.S.R. increased aid to the opposing sides. In Africa, most of the newly independent nations remained neutral. They took aid from all the major Cold War powers.

The Vietnam War threatened to turn the Cold War into a general hot war. During the early 1960's, the United States stepped up its support of South Vietnam against the Communist Viet Cong forces. The United States blamed the struggle on Communist North Vietnam, viewing the war as "aggression from the north."

The United States gradually *escalated* (increased) its military effort. In 1965, it began large-scale bombing of North Vietnam. By 1968, over 500,000 U.S. troops were in Vietnam. The Viet Cong and North Vietnamese received war materials from the Soviet Union and China.

The fighting spread throughout Indochina. Cambodia and Laos, both of which bordered South Vietnam, tried to stay neutral. But Communist forces used both countries as bases for raids into South Vietnam, and the two nations were drawn into the war. Thailand backed the West in the struggle. The United States used bases there for bombing raids on North Vietnam.

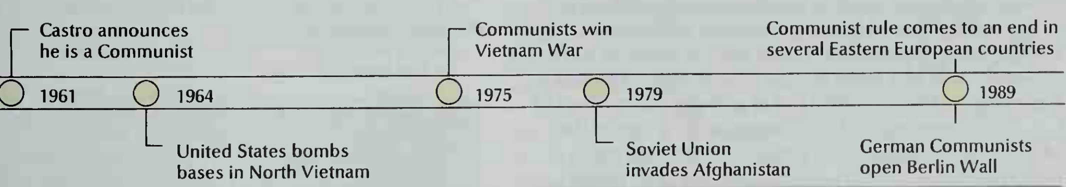
Peace talks started in Paris in May 1968. But the talks stalled, and the fighting went on. In 1969, the United States established new training programs to help the South Vietnamese take over most of the fighting. This policy became known as *Vietnamization.* Also in 1969, President Richard M. Nixon began to gradually reduce the number of U.S. soldiers in Vietnam. In 1973, the United States completed its withdrawal of ground forces. The war ended in 1975, after Communist troops conquered South Vietnam. See **Vietnam War.**

The Cold War in the 1970's

The loosening of ties among members of both the Communist and Western blocs during the 1960's led to new international relationships in the 1970's. Several Communist and democratic nations developed friendlier relations with one another, helping ease tensions.

In 1970, West Germany and Poland signed a treaty to reject the use of force and to recognize the boundaries created in Europe after World War II. West Germany and the Soviet Union ratified a similar treaty in 1972.

The status of West Berlin, a major Cold War problem, was settled in the early 1970's. France, Britain, the U.S.S.R., and the United States signed an agreement in





Wide World

Fidel Castro, *left,* declared Cuba was Communist, and was welcomed to the Soviet Union by Premier Nikita S. Khrushchev.



Francois Sully, *Newsweek*

U.S. Marines entered the Vietnam War in 1965, increasing the number of American troops in Vietnam at that time to 27,000.

1971 stating that West Berlin was not part of West Germany. The Berlin agreement also allowed free movement of traffic between West Germany and West Berlin. The pact took effect in 1972, after details were worked out. In 1973, East and West Germany joined the UN.

Also in 1973, Britain finally entered the European Community. The increased economic ties among the organization's member nations made Western Europe a powerful, independent force in world affairs. Japan also began acting more independently of U.S. policies.

China's relations with the West improved in the early 1970's. Canada and several other Western nations established diplomatic relations with Communist China for the first time. China was admitted to the UN in October 1971. In February 1972, Nixon visited China for seven days. During the visit, Nixon and Chinese Premier Zhou Enlai agreed to increase contacts between their two countries. In 1979, the United States and China established diplomatic relations. As part of the agreement, the United States ended diplomatic ties with Taiwan.

In 1972, Nixon and Soviet leader Leonid I. Brezhnev signed two agreements, together known as SALT I, to limit the production of U.S. and Soviet nuclear weapons. *SALT* stands for *S*trategic *A*rms *L*imitation *T*alks. In 1979, the two countries signed another pact, SALT II, limiting long-range bombers and missiles. But SALT II did not go into effect officially. The U.S. Senate stopped considering the treaty after Soviet troops invaded Afghanistan in late 1979 and early 1980.

The Cold War after 1980

Cold War tensions increased in the early 1980's. The renewed friction resulted chiefly from the Soviet intervention in Afghanistan and from continued American fear of Soviet and Cuban influence in the Middle East, Southeast Asia, Africa, and Central America. United States President Ronald Reagan and his Administration adopted a policy they called *linkage,* tying any U.S. arms agreement to consideration of Soviet expansion.

Meanwhile, the growing military power of the Soviet Union led the United States to increase its defense budget. Many observers thought the U.S. defense buildup would lead to a more dangerous nuclear arms race. But events in the late 1980's led to a sharp reduction in U.S.-Soviet tensions. In 1987, Reagan and Soviet leader Mikhail Gorbachev signed a treaty to eliminate many of the ground-launched, nuclear missiles of both nations. The treaty went into effect in 1988. In 1988 and 1989, the U.S.S.R. withdrew its troops from Afghanistan. Also in the late 1980's, the Soviet Union began to reduce its conventional military forces in Eastern Europe. In the U.S.S.R., Gorbachev worked for a more decentralized economic system and allowed more democracy and freedom of expression. He also encouraged similar actions in Eastern Europe.

Beginning in 1989, Communist rule came to an end in a number of Eastern European countries, including Poland, Hungary, East Germany, and Czechoslovakia. In addition, East Germany began to allow its people to pass freely to West Berlin through the Berlin Wall, and the East Germans soon began to tear the wall down. Germany was reunified in 1990, when East Germany united with West Germany. In 1991, the Soviet Communist Party lost control of the Soviet government. Later that year, the Soviet Union was dissolved, and the republics that made up the nation became independent states. Russia was by far the largest of these states. In 1992, Russian President Boris Yeltsin and U.S. President George H. W. Bush formally declared that their countries did not regard each other as potential enemies. These events marked the end of the Cold War. Burton I. Kaufman

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Astronaut
Communism
Cuban missile crisis
Democracy
Espionage
Europe (History)
Korean War
Neutrality
Peace
Quemoy
Space exploration
Third World
Vietnam War

Outline

I. The coming of the Cold War
A. The alliance breaks up
B. The Iron Curtain descends
II. The West holds the line
A. The *Containment Policy*
B. The Berlin blockade
C. The West rearms
D. Communist expansion in Asia
E. The Korean War
III. To the brink and back
A. The death of Stalin
B. The spirit of Geneva
C. Unrest in Eastern Europe
D. Trouble at Suez
IV. New challenges
A. The missile gap
B. The Eisenhower Doctrine
C. The Far East
D. Germany
E. The spirit of Camp David
F. The U-2 incident
G. Africa
H. The troika proposal
I. The Bay of Pigs
J. The Berlin Wall
K. The space race begins
L. The Cuban missile crisis
V. Easing Cold War tensions
VI. The shifting Cold War battleground
A. The great blocs split
B. The growing strength of Europe
C. Soviet-American relations
D. The invasion of Czechoslovakia
E. The battle for the neutral nations
F. The Vietnam War
VII. The Cold War in the 1970's
VIII. The Cold War after 1980

Questions

What made it difficult for the Communists and the democracies to settle disputes peacefully in the late 1940's and the 1950's?
Where did U.S. troops fight troops of a major Communist power for the first time?
How did the death of Stalin affect the Cold War?
What was the "spirit of Geneva"?
What is the *Containment Policy*?
Why did East German Communists build the Berlin Wall?
How did the U-2 incident affect the Cold War?

Why did the Cold War change during the mid-1960's?
What was the *Eisenhower Doctrine?*
What is the *hot line?* Why was it established?

Additional resources

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Cole, Nat "King" (1917-1965), was an American singer and pianist. During the early 1940's, Cole was considered one of the leading jazz pianists of his day. His trio, with guitar and bass, inspired Ahmad Jamal, Oscar Peterson, Art Tatum, and other pianists to form groups with the same instruments. Cole's vocal recording of "Straighten Up and Fly Right" (1943) won him fame as a singer. He continued to perform as a jazz musician, but his image as a singer dominated the rest of his career. Cole's vocal hits include "It's Only a Paper Moon" (1943), "The Christmas Song" (1946), "Nature Boy" (1948), and "Mona Lisa" (1950).



AP/Wide World

Nat "King" Cole

Cole was born in Montgomery, Alabama, and raised in Chicago. His given and family name was Nathaniel Adams Coles. In 1946, his trio became one of the first black music groups to have its own radio show. In 1958, he portrayed composer W. C. Handy in the movie *St. Louis Blues.* Cole's daughter, Natalie Cole, also became a successful singer. Frank Tirro

Cole, Thomas (1801-1848), was a leader of the first group of American landscape painters. Cole helped develop a distinctly American style of landscape painting.



Oil painting on canvas; Museum of Art, Rhode Island School of Design, Walter H. Kimball Fund

A Thomas Cole painting called *Landscape* was completed about 1828. The artist's Romantic style is reflected in his dramatic, panoramic treatment of the vast American wilderness.

He painted dramatic, panoramic scenes of the American wilderness in a Romantic way.

Cole first gained fame in 1825 for his scenes along the Hudson River Valley in New York. His paintings stimulated other artists of his time to paint American landscapes. This group became known as the Hudson River School. Some of Cole's paintings illustrate symbolic stories with moral themes. These works include the five canvases of *The Course of Empire* (1836) and the four works that are entitled *The Voyage of Life* (1840).

Cole was born in Lancashire, England. He and his family moved to the United States in 1818. Cole studied painting at the Pennsylvania Academy of the Fine Arts from 1823 to 1825. Sarah Burns

See also Hudson River School.

Coleman, William Thaddeus, Jr. (1920-), was United States secretary of transportation from 1975 to 1977. Coleman, appointed by President Gerald R. Ford, was the second African American Cabinet member in United States history. The first black Cabinet member was Robert Weaver, who served as secretary of housing and urban development from 1966 through 1968. As transportation secretary, Coleman worked to help the bankrupt railroads in the Northeast solve their problems. He also worked to help cities improve their transit systems.

Previously, Coleman had served as an attorney on transportation matters for the governments of Pennsylvania and Philadelphia. Coleman also is a civil rights leader. He helped write the legal argument that resulted in the 1954 decision by the Supreme Court of the United States banning segregation in public schools.

Coleman was born in Philadelphia. He graduated from the University of Pennsylvania and from Harvard Law School. William J. Eaton

Coleridge, Samuel Taylor (1772-1834), was a poet, philosopher, and critic of the English Romantic movement. His poem "The Rime of the Ancient Mariner" is one of the greatest in English literature, and all his major poems are among the most original. They embody ideals of Romanticism, a literary movement that stressed imagination, passion, and the supernatural. His literary criticism has influenced most later critics.

His life. Coleridge was born in Devonshire. He studied at Cambridge University, where he met Robert Southey in 1794. The two young poets favored the principles of the French Revolution and planned to found a *pantisocracy* (a utopian society) in the United States. They also collaborated in 1794 on a drama opposing monarchy.

In 1795, Coleridge met William Wordsworth, and they became intimate friends. They published *Lyrical Ballads* (1798), which contains the first version of "The Rime of the Ancient Mariner." In 1798, Coleridge got an *annuity* (regular income) from Josiah and Thomas Wedgwood. It enabled him to abandon a plan to become a clergyman. Then he and Wordsworth traveled to Germany. Coleridge absorbed ideas from German philosophers, especially Immanuel Kant, who influenced his own literary theories. On his return to England, he translated two plays by German author Friedrich Schiller.

About 1800, Coleridge's health began to fail. He had begun taking opium to relieve the pain of rheumatism. His marriage, never happy, caused him increasing dis-

tress after he fell in love with Wordsworth's sister-in-law, Sara Hutchinson. He spent his last years under a doctor's care, largely to control his opium addiction.

His writing. Coleridge's other famous poems are "Kubla Khan" and "Christabel." Coleridge said, possibly incorrectly, that "Kubla Khan" was inspired by an opium dream. "Christabel" is an unfinished narrative of medieval times. Both poems deal with the visionary and the supernatural, combining vivid, dreamlike images with rich literary references and intricate symbolism.

Coleridge blended keen psychological insights with precise pictures of natural scenes in his meditative lyrics, notably "Dejection: An Ode" (1802). He called many of these works "conversation poems" and addressed them to friends, including Wordsworth and essayist Charles Lamb.

Coleridge was most influential in his literary criticism. He said that a good poem has an *organic* (natural), not a *mechanical* (artificial), unity. He used this idea, among other ways, to greatly elevate the reputation of English playwright William Shakespeare. Coleridge emphasized that poetry is creative or expressive, rather than imitative, and insisted that imagination, not reason, is the foundation of the fine arts. Coleridge's best-known critical work, *Biographia Literaria* (1817), contains valuable analyses of Wordsworth's poetry. Much of Coleridge's shrewdest criticism appears in notebooks, lectures, journalistic essays, and marginal comments on other writers. A devout man, Coleridge often discussed religion, morality, and theology. Frederick W. Shilstone

See also **Lake Poets.**

Additional resources

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Colette, *koh LEHT* (1873-1954), was a French author. She was one of her country's few modern novelists who expressed a closeness to nature in her writing. Her mother had taught her tenderness for every plant and animal, and Colette expressed these feelings in her writing. Her style is sensitive and sensual and brings out the perfumes and colors of her native region of Burgundy. She also portrayed Parisian life.

Colette is especially noted for her insights into women's struggles for independence and identity. But her characters also reflect her broader interest in stages of female development, from adolescence through young womanhood, motherhood, and aging. Her novels include anecdotes from her life in the early 1900's.

Sidonie-Gabrielle Colette was born on Jan. 28, 1873, in St.-Sauveur-en-Puisaye, near Auxerre. Her first works were four autobiographical novels (1900-1904) about a girl named Claudine. Colette's other novels include *The Vagabond* (1910), *Chéri* (1920), *The Ripening Seed* (1923), *Sido* (1929), *The Cat* (1933), and *Gigi* (1944). Edith Kern

Coleus, *KOH lee uhs,* is the name for a group of plants native to tropical and nearly tropical areas of Asia, Africa, Australia, and the Pacific Islands. There are over 150 species of coleus. One of the best-known species is the *common coleus.* It is a popular house plant, largely because its leaves show patterns of white, green, yellow, pink, red, bronze, or purple in various combinations. The common coleus may grow 2 to 3 feet (61 to 91 centimeters) tall or more, but gardeners usually keep it shorter. It is a *perennial*—that is, it can live for over two years. But it cannot survive outdoors in cold regions. Gardeners grow the common coleus in pots, hanging baskets, and window boxes.



© Robert P. Comport, Earth Scenes
Coleus

Coleus plants grow easily. Seeds may be planted indoors in late winter or spring and replanted outdoors in warm weather. Pieces cut from a coleus develop in most soils or sand in a humid place at room temperature. Kenneth A. Nicely

Scientific classification. Coleus plants belong to the mint family, Lamiaceae or Labiatae. The scientific name for the common coleus is *Coleus hybridus.*

Colfax, Schuyler, *SKY lur* (1823-1885), served as vice president of the United States from 1869 to 1873 during the first term of President Ulysses S. Grant. Colfax was an active leader of the Whig and Republican parties.

Colfax was elected to the U.S. House of Representatives in 1855 and was speaker of the House from 1863 to 1869. He was an early supporter of voting rights for blacks. But his association in 1872 with the Liberal Republican Party, which opposed Grant, kept him out of the vice presidency during Grant's second term. Colfax was born on March 23, 1823, in New York City.

Irving G. Williams

See also **Credit Mobilier of America; Vice President of the United States** (picture).

Colic, *KAHL ihk,* is a severe cramping pain resulting from the contraction of any of the hollow, muscular abdominal organs, such as the stomach and intestines. Many babies and some children and adults suffer from colic. Physicians do not fully understand the causes of such pains, especially in babies. The disease may occur if the baby's digestive system has not developed enough to handle its food properly. Indigestion or constipation may cause gas to form in the intestines, resulting in colic. Some people develop colic from emotional tension. It may also be caused by arsenic or lead poisoning, blood diseases, gallstones, kidney stones, narrowing of the intestine, intestinal worms, or appendicitis.

Treatment for colic depends on the cause. Giving a baby a pacifier may help reduce tension. Patting a baby's back gently may help the baby expel gas. In some cases, it may be necessary to change the kind or amount of a baby's food. In most cases, babies outgrow the disease. A physician should be notified if colic pain persists. Adults who suffer from colic may require psychiatric counseling. Arnold Gerald Coran

Colitis, *koh LY tihs,* is a disease involving inflammation of the *colon* or other parts of the large intestine. There are three main types of colitis: (1) inflammatory colitis, (2) amebic colitis, and (3) mucous colitis.

Inflammatory colitis usually occurs in people from 20 to 40 years old. Physicians do not know what causes the disease, but many believe that nervous tension and other psychological factors may make the illness worse.

The patient suffers severe diarrhea, often accompanied by fever and rectal bleeding, particularly in a type of inflammatory colitis called ulcerative colitis. As ulcerative colitis progresses, ulcers develop in the lining of the colon and cause scarring. Drugs often help reduce the inflammation, but surgical removal of the colon may be required in extremely severe attacks. A prolonged case of ulcerative colitis greatly increases the possibility of getting cancer of the colon. Many doctors recommend surgery for patients who have had the disease for more than 10 years.

Amebic colitis results from consuming food or water contaminated by a certain type of parasitic ameba. Symptoms include abdominal cramps, diarrhea, and fever. Deep ulcers may form in the colon and may even perforate it, causing *peritonitis* (see **Peritonitis**). Physicians treat the disease with drugs, and surgery is not necessary in most cases unless perforation occurs.

Mucous colitis, also called *spastic colon,* is caused by spasms of the muscles in the wall of the colon. The patient may have severe cramps, and the feces may contain mucus—but no blood. Physicians use certain drugs and diets to relieve the symptoms. Charles S. Lieber

See also **Colon; Crohn's disease; Diarrhea; Dysentery; Inflammatory bowel disease.**

Collage, *kuh LAHZH,* is a picture or design made by gluing pieces of paper or other materials onto a canvas or another surface. The term comes from the French word *coller,* meaning *to paste* or *to glue.*

Most artists use such common items as photographs and ticket stubs to make collages. The pasted materials may be combined with lines and colors painted by the artist. By arranging the materials in a certain way, an artist can create strange or witty effects not possible in traditional painting.



Merz Drawing (1924) by Kurt Schwitters; The Museum of Modern Art, New York City, Katherine S. Dreier Bequest

Collages broke down traditional differences between painting and sculpture and influenced many art styles of the mid-1900's.

Some painters use collage to develop color compositions. For example, an artist can move a piece of colored paper over parts of a picture until the color is where the artist wants it. Art students use collage techniques to study proportion and color relationships. Many elementary schools include collage in their art courses.

Modern artists began experimenting with collage about 1912. Georges Braque, Juan Gris, and Pablo Picasso made paintings onto which they pasted pieces of paper, oilcloth, or wallpaper. In *The Bottle of Anis del Mono,* Gris used pieces of newspaper and a liqueur bottle label. Beginning about 1920, such painters as Max Ernst cut out book and magazine illustrations for collages. They pasted parts of one picture onto sections of another to create mysterious fantasies. Rebecca Jeffrey Easby

Collagen, *KAHL uh juhn,* is a protein found throughout the bodies of human beings and animals. Collagen provides strength and gives shape to connective tissues, such as ligaments and tendons, and to bones. It also provides much of the strength and flexibility in skin and blood vessels.

There are many kinds of collagens in the body. All of them are made by cells and secreted into the *intercellular substance* (material outside the cells). Single collagen molecules can come together and form larger structures, a process important in the formation of tissues.

Collagen may be damaged by injuries, such as cuts and broken bones. A major part of the process by which wounds heal involves the removal of damaged collagen, the formation of new collagen, and the shaping of this new collagen into a tissue. Many of the problems of arthritis are caused by damage to the collagen in cartilage and bone. In certain inherited disorders, collagen is abnormal. Patients with these disorders may have fragile, rubberlike skin and very loose joints. In other diseases of collagen, the bones are easily broken or the skin blistered by minor injury.

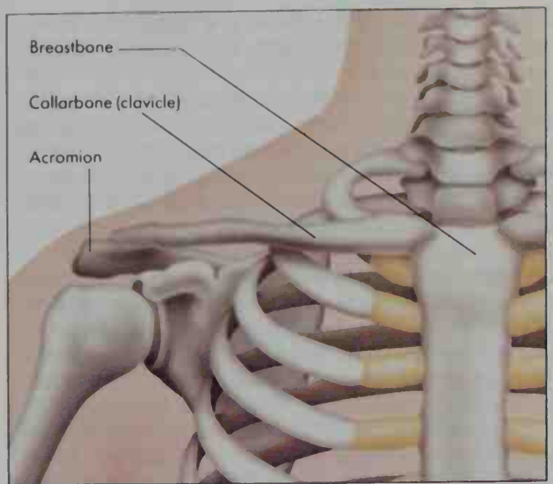
Animal collagen has many uses. Gelatin is made from collagen and is used in foods and glues. Collagen is used in shampoos and other cosmetics. In medicine, collagen is used to make artificial heart valves and to repair scars and wrinkles. George P. Stricklin

See also **Scleroderma.**

Collarbone is a long, slender, curved bone that connects the breastbone with a hooklike projection on the shoulder blade. The technical name for the collarbone is *clavicle.* The breastbone is properly called the *sternum,* the hooklike projection, *acromion,* and the shoulder blade, *scapula.*

Humans have two collarbones, one to support each shoulder. The bones are shaped somewhat like the italic letter *f.* They hold the arms in proper position at the sides of the body. When a person breaks a collarbone, the shoulder drops downward and forward toward the chest. Most broken collarbones are caused by falling on the shoulder. A hard blow on the shoulder also may break the collarbone. In addition, such a blow may tear ligaments at the joints between the clavicle, the acromion, and the sternum.

Animals that walk on four legs, such as dogs, have no collarbones. Those that hang from trees, such as



WORLD BOOK illustration by Leonard Morgan

The collarbone, or *clavicle,* connects the breastbone with the *acromion,* a hooklike projection of the shoulder blade. The collarbone holds the arm in proper position at the side of the body.

apes, have large collarbones. Occasionally, humans are born without collarbones. Bruce Reider

See also **Human body** (Trans-Vision picture).

Collards, *KAHL uhrdz,* are the leaves of the collard plant, a vegetable related to the cabbage. Collard resembles kale but can grow in warmer climates (see **Kale**). It is usually grown in the Southern United States. Collard may grow 2 to 4 feet (61 to 120 centimeters) tall. In warm climates, seeds may be planted in September and the leaves picked the following spring and summer. Seeds may also be planted in summer and the leaves picked the following winter. When cooked and eaten, collards provide a rich source of vitamin A. Hugh C. Price

Scientific classification. Collards belong to the mustard family, Brassicaceae or Cruciferae. It is *Brassica oleracea.*

Collectibles are objects from popular culture that people consider rare, unusual, or fun to own. A collectible's commercial origin separates it from fine arts objects, such as paintings, sculptures, and antiques, which also attract collectors. Some people acquire collectibles as investments, but most collectors gather the objects because of the fascination or pleasure they provide.

The number and variety of collectibles are limitless. Items that some people consider junk may be prized by others. Baseball cards and comic books rank among the most familiar items sought by collectors. Some collectors specialize in toys and puzzles, items connected with a motion picture star, a movie, a historical period, or varieties of one specific object, such as radios, teddy bears, or cookie jars. Some people collect unusual items, such as barbed wire or candle molds.

Collectors can obtain collectibles from several sources. They may visit garage sales and flea markets, hoping to discover a prized item. They can buy objects from dealers, buy or trade with other collectors, or bid for items at auction.

Some collectible objects can be purchased at small cost, while highly desired items may sell for thousands of dollars. The key to an item's value centers on its rarity, its condition, and how much it is prized by a collector. The rarer the item, the greater its worth. Collectors try to find objects in good condition. If an item is extremely rare, it may sell for a high figure even if it is in relatively poor condition.

Beginning collectors should learn as much as possible about the field that interests them before spending much money. Books, magazines, auctions, catalogs, and Internet Web sites can provide valuable information. Often, dealers and more experienced collectors will share their knowledge with beginners. New collectors should attend gallery and museum exhibits and visit museums devoted to a particular collectible. An informed collector can better determine if an item is fairly priced and whether or not the article is authentic or as valuable as the seller claims. Dona Z. Meilach

See also **Hobby** with its list of *Related articles.*

Additional resources

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Collection agency is an organization that collects the payment of past-due bills. Many physicians, dentists, hospitals, stores, and manufacturers hire a collection agency instead of spending their own time trying to collect such debts. The agency receives a fee ranging from a fourth to half of the amount it collects. There are more than 5,000 collection agencies in the United States.

A collection agency deals with a debtor chiefly through letters and telephone calls. At first, an agency may merely urge the payment of a bill so that the debtor's credit rating does not suffer. Each successive letter or call is firmer in its demand for payment. If the debtor does not pay, the agency may take legal action. It may obtain a court order requiring the debtor's employer to pay the agency part of the debtor's wages. But in many cases, the agency tells the *creditor* (the person to whom the money is owed) the money cannot be collected. The creditor then decides what legal action to take, if any. About 30 states license collection agencies, but just a few regulate collecting practices. Joanna H. Frodin

Collective behavior is a term in sociology that refers to how people act in crowds and other large, relatively unorganized groups. The various types of collective behavior include fads, panics, and riots. Collective behavior often arises in situations that stimulate people's emotions. These situations include sporting events, protest demonstrations, and disasters such as floods and fires.

Much collective behavior is brief, impulsive, and unplanned. So it differs from the more predictable, longer-lasting actions of such organized groups as school classes, teams, and clubs. Yet some types of collective behavior fit into organized social frameworks. For example, an organized political party or social movement may use mass demonstrations in seeking social change.

Before the 1900's, scientists knew little about the forces at work in collective behavior. During the 1890's, Gustave Le Bon, a French physician and social scientist, made one of the first psychological studies of crowds. The American sociologists Robert E. Park and Ernest W. Burgess introduced the term *collective behavior* in their book, *Introduction to the Science of Sociology* (1921).

Collective behavior occurs in so many forms that

social scientists have reached few conclusions about its origins, development, and consequences. Some investigators believe the pace of modern life and the growth of mass communications have increased the amount of collective behavior. Gary T. Marx

See also **Group dynamics; Riot; Vandalism.**

Collective farm is a farm operated by a group cooperatively. The farm may be owned jointly by the group, by individuals in the group, or by the government. On most collective farms, workers receive a share of the farm's profits, some of its products, and a small wage. In many countries, the workers also help manage the farm. Collective farms differ from *state farms,* which the government owns and runs. On state farms, the government pays the workers a wage and, in some cases, gives them a small portion of the farm's products.

Collective farms were introduced in Russia after Communists gained control there in 1917. Beginning in 1929, Soviet dictator Joseph Stalin forced millions of peasants to give up their land and join government-controlled collective farms. Later, he combined some of these farms to create state farms. Soviet leaders thought the collective and state farms would be more efficient and productive than the tiny family farms they replaced. After World War II ended in 1945, new Communist governments in China, North Korea, and most countries of Eastern Europe imitated the Soviet system.

But the collective and state farms in Communist countries proved to be inefficient and unpopular. Most farmers resented their low earnings and the government's tight control over production. As a result, production remained below government expectations, and food shortages became common.

In the late 1980's, non-Communist governments replaced Communist governments in many countries of Eastern Europe. In 1991, the Soviet Union broke up into a number of independent, non-Communist states. All Eastern European countries in which the government had owned most farms—and many of the former Soviet states—took steps to redistribute much state-owned land to private farmers. Stuart D. Goldman

Collectivism is a political and economic system in which the government or the people as a group own the land, factories, and other means of production. Collectivism originated during the early 1800's as a revolt against *capitalism,* the most popular economic system of the time. Capitalism called for individual ownership of property and little government intervention in business. Collectivists claimed these ideas led to poverty, unemployment, and other hardships for workers. Such writers as Robert Owen of Britain and Charles Fourier of France called for a new economic system based on cooperation and collective ownership. Their ideas led to the establishment of cooperative communities in the United States, including Brook Farm, Massachusetts, and New Harmony, Indiana.

Several forms of collectivism developed during the late 1800's. They included *syndicalism,* which called for workers to own and manage industries, and *cooperatives,* which are businesses owned by the people who use their services. Major modern forms of collectivism include *communism* and *socialism.* Richard C. Wiles

See also **Communal society; Cooperative; Socialism; Syndicalism; Welfare state.**

College. See Community college; Universities and colleges.

College degree. See Degree, College.

College entrance examination is a test or a series of tests that helps determine whether a person meets the admission requirements of a college or university. Most colleges throughout the world require applicants to take some kind of entrance examination. Colleges that require these tests also have other standards for admission, such as good high school grades and strong personal recommendations.

Many nations have established one examination that all students must pass to qualify for admission to a university. The United States has no such test. Instead, many schools in the United States require applicants to take examinations given by the College Entrance Examination Board (CEEB). Others require tests prepared by the American College Testing Program. Many schools accept scores from either of these agencies. Each agency's examinations are given several times each year throughout the United States and other countries.

The College Entrance Examination Board gives two types of entrance examinations, known as the SAT's. These tests are the *SAT I: Reasoning Test* and the *SAT II: Subject Tests.* Information about the CEEB tests is available from the College Entrance Examination Board in New York City.

The SAT I consists primarily of multiple-choice questions and has two sections: (1) verbal and (2) mathematical. The verbal section of the test measures reading comprehension and the ability to understand word relationships. The mathematical section of the test measures the ability to understand mathematical concepts and to use them in solving problems.

Students can prepare for the SAT I by taking the CEEB's Preliminary SAT (PSAT). Most high schools give the PSAT to 11th-graders each October. The PSAT is also the qualifying test for National Merit Scholarships.

The SAT II tests are one-hour tests that measure a student's knowledge in such specific subject areas as foreign language, mathematics, science, and writing. Some schools that require applicants to take the SAT I do not require them to take any of the SAT II's. Many schools that require SAT II's ask their applicants to take tests in three subjects. Most SAT II's consist of multiple-choice questions. However, the writing test also requires a 20-minute writing sample.

The American College Testing Program examination, known as the ACT test, has two parts. The major part consists of four tests: (1) English, (2) mathematics, (3) science reasoning, and (4) reading. These tests also use multiple-choice questions. The second part of the examination is the Student Profile. Students complete this section by answering a series of questions about their achievements, goals, and special interests. Information about the ACT tests can be obtained from the American College Testing Program in Iowa City, Iowa.

Scores on the SAT I and SAT II's range from 200 to 800 points. There is no "passing" grade, and each college has its own standards for evaluating scores. The CEEB helps students interpret their test results by providing a *percentile rank* for each score. The percentile rank shows how a student's score compares with the scores of others who took the test. For example, a score

of 500 on the verbal section might place a student at the 50th percentile compared with a national sample of high school juniors and seniors. In other words, the student scored higher than 50 percent of the sample group.

The ACT tests are scored on a scale that ranges from 1 to 36. In addition, the ACT provides a percentile rank for each score.

Both the American College Testing Program and the CEEB send score reports to the student's high school and to the colleges to which the student is applying. A student can request as part of his or her CEEB score report a listing of percentile ranks for three specific colleges. This listing shows how the student's scores compare with the scores of the members of the freshman class at those schools.

Some educators criticize the emphasis placed on test scores. They believe that the tests measure only a few of the many abilities needed for success in college. Also, they claim that use of the tests does not change many admission decisions. Some educators say that the tests may discriminate against disadvantaged and minority groups.

The Advanced Placement Program (AP) is a CEEB testing program that allows high school students to earn college credit for knowledge that they have gained in high school. Each May, the AP offers college-level examinations in many high school subjects. A sufficiently high score on one of these tests may qualify a student to receive credit for college work in the subject. A student who scores well on several tests may be given sophomore instead of freshman status. James Crouse

Collie is a breed of dog that originated in Scotland, probably during the 1600's. Scottish farmers used the dog to guard and control flocks of sheep. Like other sheepdogs, collies have a thick, weatherproof coat. Their intelligence, willingness to work, and good eyesight suit these dogs for taking care of sheep. British colonists brought collies to America during the 1700's. The dogs became popular as pets after Queen Victoria of England brought several collies to the royal residence at Windsor Castle in the 1860's.

The most common variety of collie has a coarse, long-haired coat. Another variety has a smooth, short-haired coat. A collie may be brown and white; black, white, and tan; blue-gray; or all white. The dogs stand about 22 to 26 inches (56 to 66 centimeters) high and weigh from 50 to 75 pounds (23 to 34 kilograms).


WORLD BOOK photo
A short-haired collie has a smooth, short coat.

Critically reviewed by the Collie Club of America

See also **Border collie.**

Collins, Eileen Marie (1956-), is the first woman to command a space shuttle. She commanded the shuttle Columbia on an orbital flight from July 23 to 28, 1999. During the flight, the shuttle launched the Chandra X-ray Observatory, an orbiting telescope.


NASA
Eileen Collins

Collins was born in Elmira, New York. She earned a bachelor's degree in mathematics and economics from Syracuse University in 1978. She also earned two master's degrees, one in operations research from Stanford University in 1986 and the other in space systems management from Webster University in 1989.

Collins enlisted in the United States Air Force in 1978. Before becoming an astronaut in 1991, she worked as a test pilot and as a math instructor at the Air Force Academy. She holds the rank of colonel. James Oberg

Collins, Wilkie (1824-1889), an English author, was one of the most successful writers of detective fiction in the 1800's. *The Woman in White* (1860) and *The Moonstone* (1868) rank as his best and most popular novels.

Some critics rank *The Moonstone* among the world's outstanding detective stories. Sergeant Cuff, a character in the novel, was one of the first detectives in English fiction. The book is about a diamond called the moonstone which is stolen from the forehead of an image of the moon god of India. A curse, and sometimes murder, follows the diamond until it is returned.

William Wilkie Collins was born in London. He became a lawyer in 1851 but never practiced law. However, he used his knowledge of law in writing his books. Collins gained his first literary success with *Antonina* (1850), a historical novel set in ancient Rome. In 1851, he met Charles Dickens and the two became close friends. Collins's first important mystery novel, *The Dead Secret* (1857), appeared in Dickens's magazine *Household Words.* David Geherin

Collodi, *kuh LOH dih,* **Carlo** (1826-1890), an Italian author, wrote the famous children's story *The Adventures of Pinocchio* (1883). His real name was Carlo Lorenzini. He took the pen name *Collodi* from the village where he spent much of his youth. Collodi was born in Florence and worked as a journalist for many years. He also wrote humorous fiction for adults and many children's stories.

In Collodi's famous story, Pinocchio is a wooden puppet carved by a kindly old man named Geppetto. The puppet comes to life and has many unhappy adventures because he is lazy and selfish. At the end of the story, Pinocchio has learned to be generous and honest and to work hard. As a reward, a fairy grants his wish and turns him into a real boy. Richard H. Lansing

Colloid, *KAHL oyd,* is a material composed of tiny particles of one substance that are *dispersed* (distributed), but not dissolved, in another substance. The mixture of the two substances is a *colloidal system.* A colloidal system composed of solid or liquid particles dispersed in a gas is called an *aerosol* (see **Aerosol**). A system made up of solid or liquid particles in water is sometimes called a *sol* or a *hydrosol.* The word *colloid* is often used alone to mean *colloidal system.* The remainder of this article uses *colloid* in this way.

Colloids include such familiar products as milk, soap solutions, paint, and ink. Other common products, such as pottery and paper, are made from colloids. Blood and most other fluids in living things are colloids.

The solid particles of a colloid may be crystals, groups of molecules, or large, single molecules. At least one dimension of a typical colloidal particle measures between a few nanometers and a few thousand nanometers. One nanometer equals one billionth of a meter, or $\frac{1}{25,400,000}$ inch. Some particles are too small to see, even with an optical microscope. They scatter light, however, producing bright dots that are visible in an instrument called an *ultramicroscope* (see **Ultramicroscope**).

Liquid colloids can be divided into three groups: (1) lyophobic, (2) lyophilic, and (3) association.

In lyophobic colloids, the particles have little attraction for the liquid in which they are dispersed. As a result, the particles tend to *coagulate* (clump). Mixing a chemical called a *dispersant* with a lyophobic colloid can decrease this tendency, however. For example, dispersants minimize the coagulation of pigments that give certain inks their color.

In lyophilic colloids, there is an attraction between the particles and the liquid, so the particles have little tendency to coagulate. Many animal and plant fluids, such as blood and gums, are lyophilic colloids.

In association colloids, the colloidal particles are large molecules that are part lyophilic and part lyophobic. These molecules form clusters called *micelles* that turn their lyophobic parts away from the liquid molecules and expose only the lyophilic parts. Soaps and detergents are association colloids. Their micelles surround and hold oily pieces of dirt. R. Hogg

Colobus, *KAHL uh buhs,* is a type of monkey that lives in Africa south of the Sahara to the Zambezi River. Adult colobus monkeys weigh from 6 $\frac{1}{2}$ to 32 pounds (2.9 to 14.5 kilograms), depending on the species. They measure from 16 to 31 $\frac{1}{2}$ inches (41 to 80 centimeters) long, not including a 20 $\frac{1}{2}$- to 39 $\frac{1}{2}$- inch (52- to 100-centimeter) tail. Males are larger than females in most species. Colobus monkeys have a stocky build. Their fur may be black, black and white, red, or olive. Unlike most other monkeys, colobus monkeys have no thumbs. Many scientists recognize nine species of colobus monkeys.

Most colobus monkeys live in a variety of forested environments, including tropical rain forests, wooded mountain areas, and patches of forests along rivers. They live mainly in trees but frequently travel on the ground. Colobus monkeys are called "leaf-monkeys" because they eat chiefly leaves. They also eat fruit, flower buds, bark, and other plant parts.

Colobus monkeys live in groups that range from about 3 to 80 members. Most groups consist of a few adult males and several adult females and their young. Some groups have only one adult male. Black-and-white colobus monkeys aggressively defend their territory from other groups. Red colobus monkeys generally do not defend their home areas.

The number of colobus monkeys has declined significantly since the late 1800's. Both the hunting of the monkeys for their fur and the clearing of forests for settlements and agriculture have contributed to their decline. In some regions, entire populations of colobus monkeys have been eliminated. Randall L. Susman

Scientific classification. Colobus monkeys belong to the Old World monkey family, Cercopithecidae.

See also **Monkey** (picture: Red colobus).

Cologne, a perfume. See **Cologne; Perfume.**

Cologne, *kuh LOHN* (pop. 953,551), is a city in western Germany. For location, see **Germany** (political map). The German name of the city is Köln. Cologne lies along the Rhine River. It is the largest city in the state of North Rhine-Westphalia and the chief industrial, commercial, and cultural center of the large region called the Rhineland.

The *Ringstrassen,* a network of semicircular roads, forms Cologne's boundary line. These roads replaced the city's medieval fortified walls. Most of Cologne's commercial and residential areas lie on the west bank of the Rhine River. Most of the industrial areas are on the east bank. The city has numerous museums, theaters, libraries, and schools of higher education.

Cologne Cathedral is the city's most famous landmark. A magnificent Gothic structure, the cathedral features two 515-foot (157-meter) towers, beautiful stained-glass windows, and lovely works of art. It was started in 1248, but was not completed until 1880. The cathedral is the largest Gothic church in northern Europe. Cologne's numerous other medieval buildings include the old City Hall, which dates from the 1300's. Cologne University, the city's largest school of higher education, was founded in 1388.

Cologne's major industries include metal processing and the production of automobiles, beer, chemicals, electric power, motors, pharmaceuticals, and petrochemicals. A world-famous perfume called *eau de Cologne* was originally made in Cologne and is now produced both there and elsewhere. Cologne has long been an important river port and railroad center, and it has a large, modern airport. It is also a center of the insurance business in Germany.

Roman soldiers established a settlement on the site of what is now Cologne not long before the birth of Jesus Christ. The Ubii, an ancient Germanic people, had lived there long before the Romans arrived. Roman officials made the settlement a colony in A.D. 50. Norman invaders destroyed Cologne during the late 800's. The city was rebuilt in the 900's. From then until the 1500's, it prospered as an important member of the Holy Roman Empire (see **Holy Roman Empire**). France occupied Cologne from 1794 to 1815, when Prussia took the city. In 1871, Cologne became part of the newly united nation of Germany.

During World War II (1939-1945), Allied bombing attacks destroyed many parts of Cologne and forced most of the residents to leave. However, most of the people returned after the war, and the destroyed and damaged areas were soon rebuilt. Melvin Croan



Carl Purcell, Tom Stack & Assoc.

Bogotá, Colombia's capital and largest city, lies in a basin high in the Andes Mountains. Steep mountains rise east of the city. The cable car in the foreground carries sightseers to one of the mountaintops for a spectacular aerial view of Bogotá.

Colombia

Colombia, *kuh LUHM bee uh,* is a country in northwestern South America. It is the only country on the continent with a coast along both the Atlantic Ocean and the Pacific Ocean. Colombia ranks second in population and fourth in area among the countries of South America. Only Brazil has more people, and only Brazil, Argentina, and Peru cover a larger area.

Colombia's landscape and climate offer striking contrasts, ranging from the snow-capped peaks of the Andes Mountains to hot lowland plains. The equator crosses southern Colombia. Yet parts of the country have a chilly climate because of their high elevation.

The population of Colombia is distributed extremely unevenly. Most of the people live in valleys and basins of the Andes Mountains. Bogotá, Colombia's capital and largest city, lies in a basin of the Andes.

The differences in climate throughout Colombia enable farmers to grow many kinds of crops, including coffee, rice, bananas, and potatoes. Colombia produces more coffee than any other country except Brazil.

Colombia's economy depends heavily on agriculture, though manufacturing is growing in importance. Colombia has huge supplies of many raw materials used in industry and enormous sources of energy. However, the country has not fully developed its vast resources.

During the early 1500's, Colombia's natural wealth, especially its gold, attracted Spanish explorers. The Spaniards conquered most of the Indians, the region's original inhabitants. Colombia remained a Spanish colony for nearly 300 years. After gaining independence in 1819, it suffered long periods of violence and civil war. But unlike some other Latin American countries, Colombia has a tradition of democratic government.

Colombia was named after Christopher Columbus. The nation's official name is República de Colombia (Republic of Colombia).

Government

Colombia is a republic. Its Constitution was adopted in 1991. All citizens 18 years of age and older may vote.

National government. A president, elected by the people to a four-year term, heads the government. The president may be elected to only one term. The people also elect the vice president for one four-year term. The vice president takes over the presidency upon the death, illness, or resignation of the president. Congress, the nation's legislature, consists of a 102-member Senate and a 161-member House of Representatives. Voters elect senators and representatives to four-year terms.

Facts in brief

Capital: Bogotá.
Official language: Spanish.
Area: 439,737 mi² (1,138,914 km²). *Greatest distances*—northwest-southeast, 1,170 mi (1,883 km); northeast-southwest, 850 mi (1,368 km). *Coastline*—580 mi (933 km) along the Pacific Ocean; 710 mi (1,143 km) along the Caribbean Sea.
Elevation: *Highest*—Cristóbal Colón, 18,947 ft (5,775 m) above sea level. *Lowest*—sea level, along the coasts.
Population: *Estimated 2002 population*—43,755,000; density, 100 per mi² (38 per km²); distribution, 71 percent urban, 29 percent rural. *1993 census*—33,109,840.
Chief products: *Agriculture*—bananas, beef cattle, cassava, coffee, corn, cotton, milk, potatoes, rice, sugar cane. *Manufacturing*—cement, chemicals, metal products, processed foods and beverages, textiles and clothing. *Mining*—coal, emeralds, gold, iron ore, natural gas, petroleum, salt.
Money: *Basic unit*—peso. One hundred centavos equal one peso.

Local government. Colombia is divided into 32 departments and the Capital District, which consists of Bogotá. Each department has a governor appointed by the president and an assembly elected by the people. A mayor appointed by the president governs the Capital District.

Politics. Two parties have long dominated Colombian politics. They are the Conservative Party and the Liberal Party. Both parties follow moderate policies. But most Colombians strongly support one or the other.

Courts. Colombia has four judicial bodies that are equal in rank. The Supreme Court of Justice is the highest court of criminal law. The Council of State is the highest court of administrative law. The Constitutional Court is the highest court for constitutional matters and international treaties. The Superior Judicial Council administers the government's judicial branch and disciplines judges.

Armed forces. Colombia's army has about 130,000 members, its navy about 15,000, and its air force about 8,000. All men 18 years old must register for the military draft.

People

Nearly all of Colombia's people live in the western part of the country, mainly in valleys and basins of the Andes Mountains. Only about 2 percent of the people live in the hot lowlands of eastern Colombia.

Bogotá, the capital, is Colombia's largest city. It has over 5 million people. Three other Colombian cities—Cali, Medellín, and Barranquilla—have more than a million people each. Rural Colombians, called *campesinos,* have poured into the nation's large cities since the 1940's in search of a better life. Many campesinos lack the education and skills needed for city jobs. As a result, Colombia's large cities have such problems as poverty, unemployment, slum housing, and high crime rates.

Ancestry. Many Indians lived in what is now Colombia when the first Spanish colonists arrived in the 1500's. The Spaniards conquered the Indians and later brought in black slaves from Africa. Over the years, many Indians, Spaniards, and blacks intermarried. Today, *mestizos* (people of mixed white and Indian ancestry) make up from 50 to 60 percent of Colombia's population. *Mulattoes* (people of mixed black and white ancestry) account for 15 to 25 percent. *Zambos* (people of black and Indian ancestry) make up about 3 percent of all Colombians. About 20 percent of the people are of unmixed European ancestry, chiefly Spanish. About 4 percent are of unmixed black ancestry, and about 1 percent are of unmixed Indian ancestry.

Language. Nearly all Colombians speak Spanish, the country's official language. Colombians closely guard their language to keep it from changing. They even passed a law to protect it from unnecessary change. Colombians consider their Spanish purer than that of other Latin-American countries. The traditional languages of Colombia's Indians have largely died out.

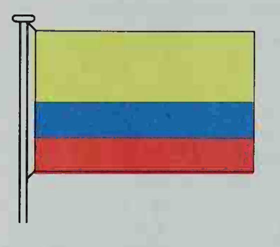
Way of life. In general, city dwellers in Colombia live better than country people. The cities have most of the nation's schools, medical facilities, and cultural activities. The majority of middle- and upper-class Colombians live in cities.

In Colombia's large cities, tall office and apartment

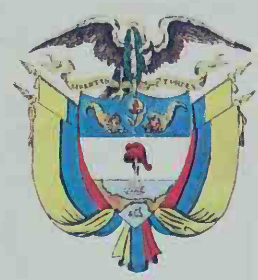


Chip and Rosa Peterson

Masked and costumed Colombians parade down the streets of Barranquilla during carnival. The colorful festival of carnival is celebrated just before Lent in many Roman Catholic countries.



Colombia's flag, adopted in 1861, has a yellow stripe for the golden New World, a red stripe for the blood shed for independence, and a blue stripe for the Atlantic Ocean.



The coat of arms, adopted in 1834, is topped by a condor. It shows a pomegranate, horns of plenty, a liberty cap, and the Isthmus of Panama (once part of Colombia).



WORLD BOOK map

Colombia lies in northwestern South America. It borders five other countries, the Pacific Ocean, and the Caribbean Sea.

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Vaupés River ..... F 4
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*Not on map; key shows general location.
†Not on map; island group in Caribbean Sea off coast of Nicaragua.
Source: 1993 census.

Colombia

International boundary
Road
Railroad
National capital
Other city or town
Elevation above sea level

WORLD BOOK map

buildings are replacing the traditional Spanish-style architecture. Spanish-style buildings are low, sprawling adobe structures with red tile roofs and patios.

Many rural Colombians build simple houses from locally available materials. In the warm, wet coastal regions, for example, they use bamboo poles and palm leaves to build well-ventilated houses. But in the cooler mountain zones, many houses have thick adobe walls.

Many Colombian families are large. Rural families especially include numerous children. Family ties are strong. Several generations may live in the same household or as neighbors. In general, women have less freedom than men do, particularly among the upper class.

Most members of Colombia's small upper class are descended from the country's Spanish settlers. They form a tightly knit group and socialize mainly with other members of the upper class. Their wealth has traditionally come chiefly from large rural landholdings. But today, more and more upper-class Colombians make their money in business and industry.

In Colombia's cities, the size of the middle class and the working class is growing as developing industries provide many new jobs. The middle class includes business people, government officials, and such professionals as doctors, lawyers, and engineers. Middle-class Colombians live in comfortable houses or apartments in attractive neighborhoods. Working-class people include salesclerks, factory and construction workers, and other Colombians with low-paying jobs. Many of them live in run-down buildings in older neighborhoods.

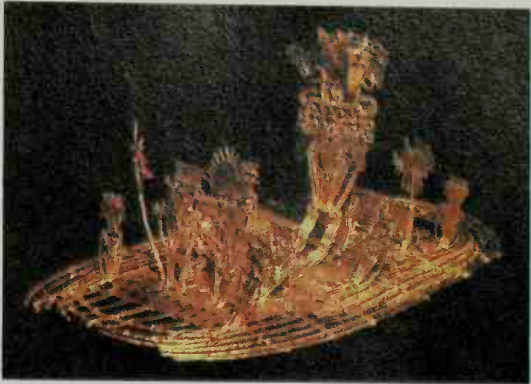
Crowded slumlike squatter settlements stand at the edges of Colombia's large cities. They are called *tugurios* (pronounced *too GOO ree ohz*). Most tugurios have no running water, electricity, or sewers. Many newcomers from rural areas build shacks in the tugurios out of tin, cardboard, and other scrap materials. Some children in these areas run away or are abandoned by their parents, who cannot support them. These homeless children, called *gamines* (*gah MEE nays*), roam the streets and alleys. Most are boys.

Education. Most of Colombia's adults can read and write. For the country's literacy rate, see **Literacy** (table: Literacy rates). The Colombian government requires all children to attend school for at least five years. However, many rural children cannot meet this requirement because their schools have only two or three grades. Colombia has about 40 universities. The National University in Bogotá is the largest university.

Clothing. Most of Colombia's city dwellers dress much like people in the United States and Canada. Most rural people have few garments, and some of them wear shoes only on special occasions. In chilly mountain areas, many Colombians wear woolen *ruanas* (blankets with a slit in the middle for the head).

Food and drink. Different regions of Colombia have their own special dishes. In general, however, Colombians eat much starchy food, such as potatoes, rice, and noodles. They enjoy stews and thick soups. A favorite soup, called *ajiaco* (*ah hee AH koh*), contains potatoes, chicken, corn, and *cassava* (a root crop). Poor Colombians eat little meat and few fresh fruits or vegetables.

Both adults and children drink *agua de panela* (*AH gwah day pah NEHL ah*), a beverage consisting of brown sugar dissolved in water. Colombians also drink much



Loren McIntyre, Cher Agency

The Raft of El Dorado is an example of the elegant sculptures made by Indian goldsmiths hundreds of years ago. It represents the coronation of a new Chibcha ruler. The ruler was covered with gold dust to represent a god and then rowed out on a lake and washed free of the gold to represent a human ruler.

of the beer produced in the country. Although Colombia is a leading coffee producer, most Colombians do not drink as much coffee as Americans do.

Recreation. Soccer is by far the most popular spectator sport in Colombia. Bullfights and auto races also draw large crowds. Swimmers and sunbathers enjoy the beaches along the Caribbean coast, and the snow-capped slopes of the Andes attract skiers. Folk songs and dances preserve the traditional music and dances of the Indians, Spanish colonists, and black African slaves.

Religion. Nearly all Colombians are Roman Catholics, and most of them actively practice their religion. The Catholic Church has a close relationship with the government. However, Colombia's Constitution guarantees freedom of worship.

The arts. Advanced Indian civilizations created Colombia's earliest works of art hundreds of years ago. Gigantic stone statues of Indian gods still stand high in the Andes Mountains in southern Colombia. Bogotá's Gold Museum displays elegant jewelry, small figures, and other beautiful objects crafted by Indian goldsmiths.

Indian artistic traditions were gradually forgotten after Spanish colonists arrived in Colombia. Until the 1900's, Colombia's arts largely reflected European styles. During the mid-1900's, several Colombian artists won international recognition for their original works. They include the painters Fernando Botero and Alejandro Obregón and the sculptor Edgar Negret.

Colombians greatly admire writers, especially poets. Many Colombian lawyers, teachers, and other professionals write poetry in their spare time. *María* (1867), a novel by Jorge Isaacs, became the first work of Colombian literature to win popularity throughout Latin America. It is a sentimental tale of love and death set in rural Colombia. Colombia's most outstanding writer today, Gabriel José García Márquez, won the Nobel Prize for literature in 1982. His tales about life in Latin America combine fantasy with realistic description.

The land

Colombia covers 439,737 square miles (1,138,914 square kilometers). It can be divided into three main

land regions: (1) the Coastal Lowlands, (2) the Andes Mountains, and (3) the Eastern Plains.

The Coastal Lowlands lie along the Caribbean Sea and the Pacific Ocean. The Caribbean is an arm of the Atlantic Ocean.

The Caribbean Lowlands have about 20 percent of Colombia's people and about 12 percent of its industry. The busy Caribbean ports of Barranquilla, Cartagena, and Santa Marta handle most of Colombia's foreign trade. Beyond these cities lie banana, cotton, and sugar cane plantations; cattle ranches; and many small farms. The narrow Guajira Peninsula forms the northernmost tip of Columbia. It is a dry area and has excellent coal deposits. The peninsula is the home of many Guajiro Indians.

The Pacific Lowlands consist mostly of swamps and dense forests. Heavy rains fall nearly every day. Few people live in the region.

The Andes Mountains cover about a third of Colombia. They fan out from the southwestern corner of the country into three ranges—Cordillera Central, Cordillera Oriental, and Cordillera Occidental. The mountain ranges stretch northeast across western Colombia. They include the Nevado del Ruiz, an active volcano west of Bogotá. In 1985, Nevado del Ruiz erupted twice and caused 25,000 deaths. The eruptions triggered floods and mud slides that buried the city of Armero and damaged other areas. An isolated range of the Andes, the Sierra Nevada de Santa Marta, rises from the Caribbean coast. It includes Colombia's highest peak, Cristóbal Colón, which rises 18,947 feet (5,775 meters) above sea level.

About three-fourths of Colombia's people live in the Andes. Rich mines, fertile farms, and large factories in valleys and basins of the Andes produce most of Colombia's wealth. Coffee trees thrive on mountain slopes in areas of mild climate. Colombia's two most important rivers separate the three ranges. The Magdalena River separates the Cordillera Central and the Cordillera Oriental. The Cauca River separates the Cordillera Central and the Cordillera Occidental. Farmers grow various crops in the rich soil of the river valleys.

The Eastern Plains spread over nearly 60 percent of Colombia. Only about 2 percent of the people live in this hot, flat region. Tropical forests cover much of the south. In the north, farmers graze cattle on prairielike grassland called *llanos*. Several rivers cross the plains.

Climate

Colombia's climate varies with elevation. The highest temperatures occur at the lowest altitudes—in the Coastal Lowlands and the Eastern Plains. Temperatures are much lower in the Andes Mountains. A zone of mild climate lies between 3,000 and 6,000 feet (900 and 1,800 meters). Above 6,000 feet (1,800 meters), the climate is cool the year around. Few people live in the cold mountain areas above 10,000 feet (3,000 meters).

Temperatures within a region vary little from season to season. For example, Bogotá, which lies about 8,660 feet (2,640 meters) above sea level in the Andes, has an average temperature of 58 °F (14 °C) in January and 57 °F (14 °C) in July. Each year, most of Colombia has one or two wet seasons with heavy daily rainfall, and one or two dry seasons with little or no rainfall.



Victor Englebert, ZEFA

Colombia's Eastern Plains consist mainly of flat grassland. Raising cattle is the chief economic activity in this region.

Economy

Colombia is a developing country. Its economy has long depended heavily on agriculture. Since the 1950's, however, manufacturing has steadily grown in importance. Most businesses are privately owned. But the government is active in guiding the economy.

Agriculture employs slightly more than a fifth of Colombia's workers and accounts for about half of all export earnings. The country's varied climate and terrain enable farmers to grow a variety of products.

Coffee is Colombia's leading export crop by far. About an eighth of the world's trade in coffee comes from Colombia. Coffee trees grow on more than 300,000 small Colombian farms. Other major crops include bananas, cassava, corn, cotton, potatoes, rice, and sugar cane. Cattle are raised for meat, milk, and leather exports. Flowers are also an important source of income.

A small number of wealthy landholders own most of the farmland in Colombia not used to grow coffee. They hire workers or rent land to tenant farmers. Tenant farmers and many landowners work very small farms and produce barely enough to feed their families.

Manufacturing employs about a fifth of Colombia's workers. Most factories are in or near Bogotá, Medellín, and Cali. Many of them are small, family-operated plants. Colombia's chief manufactured products include textiles and clothing, processed foods and beverages, chemicals, metal products, and cement.

Mining is a rapidly growing industry in Colombia. Petroleum and coal are major exports. Colombia also has large reserves of natural gas and iron ore. In addition, it supplies more than 90 percent of the world's emeralds. It is also a leading producer of gold. Large underground salt deposits supply the raw material for Colombia's thriving chemical industry.

Service industries include stores, banks, insurance firms, transportation and communication companies, and community service institutions, such as schools, hospitals, and government agencies. Service industries employ about two-fifths of all Colombian workers. Many of these workers, such as salespeople and office clerks, hold low-paying jobs that require few skills.

Energy sources. Hydroelectric plants supply about 70 percent of Colombia's electric power. Oil, gas, and

coal produce the rest. In spite of Colombia's vast energy resources, some rural areas lack electric service.

Trade. Coffee and petroleum are Colombia's leading exports. The country's other exports include bananas, coal, flowers, and textiles and leather goods. Colombia's chief imports include chemicals, machinery, and transportation equipment. Colombia trades mainly with the United States, Venezuela, Japan, and Germany.

The smuggling of illegal drugs, such as cocaine, from Colombia into the United States and other countries produces a large amount of income. However, only a few Colombians control the drug traffic and benefit from the huge sums of money brought into the country. See also the *Recent developments* section of this article.

Transportation and communication. The Magdalena River once served as Colombia's chief transportation route. A major railway and highway run along its valley. Less than 3 percent of Colombians own an automobile. Bus travel is popular. Bus routes link most cities. Air travel is very important because of the rugged terrain. Airlines serve all parts of the country. Bogotá, Medellín, and Cali have major international airports.

Colombia has an average of about 1 radio for every 6 people and 1 television set for every 9 people. About 30 daily newspapers are published in the country. *El Espectador* and *El Tiempo* have the largest circulations. Both are independently owned and published in Bogotá, though they are sold throughout the country. Many of Colombia's political leaders, including several former presidents, have been journalists or newspaper editors.

History

Early days. Many Indian groups lived in what is now Colombia long before the first Europeans arrived. They included settled farming communities and nomadic hunting and fishing groups. The Chibcha, an advanced civilization in the Andes, traded emeralds and salt for gold and cotton with Indians along the coast.

By 1500, Spanish explorers had sailed along Colombia's Caribbean coast. The first permanent Spanish settlement in South America was founded at Santa Marta in 1525. A Spanish lawyer, Gonzalo Jiménez de Quesada, led an expedition into the Andes from 1536 to 1538 and conquered the Chibcha. In 1538, Jiménez de Quesada founded Sante Fe de Bogotá (now Bogotá). He called the surrounding area the New Kingdom of Granada because it reminded him of the area in Spain known as Granada.

Spanish rule spread over the New Kingdom of Granada as colonists founded more towns. The colony lacked the mineral wealth of Mexico and Peru. But it produced emeralds, platinum, and some gold. Spanish settlers in the Andes forced Indians to work in mines and on large estates that raised cattle and grain. Many Indians died of mistreatment or of diseases brought by Spaniards. Some Indians and Spaniards intermarried. On the Caribbean coast, Spaniards imported African slaves to work on sugar cane and cacao plantations.

Most settlements in the New Kingdom of Granada were isolated by rugged terrain, which made the colony difficult to unify and to govern. In 1564, Spain appointed a president to govern the colony. In the early 1700's, Spain combined the colony with nearby territories into one large colony called the Viceroyalty of New Granada. It consisted of what are now Colombia, Venezuela, Ecuador, and Panama. Bogotá was the capital.

Independence. Although New Granada had some able presidents, many colonists disliked Spanish rule. In 1780 and 1781, many people violently protested against new taxes. Spain crushed the revolt. But a movement for independence had begun.

Most parts of the viceroyalty set up independent governments in 1810. The French army occupied Spain at that time, and Spain's South American colonies took advantage of the mother country's weakness to declare their freedom. Spain sent troops to South America after the defeat of France in 1814. Bitter fighting followed.

In 1819, the Venezuelan general Simón Bolívar defeated Spain in the Battle of Boyacá, north of Bogotá. Bolívar then became the first president of Gran Colombia, a republic made up of the territory of the former viceroyalty. The name Colombia was chosen in honor of Christopher Columbus. Gran Colombia lasted only a short time. By 1830, Venezuela and Ecuador had broken away and become separate nations.

Political disorder troubled Colombia from its start as a separate country. Conflicts arose over how strong the central government should be and how much influence the Roman Catholic Church should have on the government. These conflicts split the country into two groups. One group supported a strong central government and a powerful role for the church. It later became the Conservative Party. The other group favored a weak central government and strong regional governments. This group, which became the Liberal Party, also wanted to limit the role of the church.

Disputes between the Liberal and Conservative parties often erupted into civil war. The country had nine constitutions after independence, partly because each administration wanted to write a new constitution after taking office. The Constitution of 1853 abolished slavery. The Constitution of 1886, which established the Republic of Colombia, represented a victory for the Conservatives. It provided for a strong central government. But it did not prevent a fierce civil war, called the War of the Thousand Days, which was fought from 1899 to 1902.

The 1900's. Colombia lost Panama in 1903. That year, the Colombian Senate refused to approve a treaty that allowed the United States to build a canal across Panama. Panama then revolted against Colombia with help from U.S. forces and quickly agreed to the canal project. In 1922, the United States paid Colombia $25 million for the loss of Panama. During World War II (1939-1945), Colombia helped keep the Panama Canal open.

Disputes between the two major political parties reached a climax in 1948. That year, a popular Liberal leader, Jorge Eliécer Gaitán, was assassinated in Bogotá. Riots followed that left the center of Bogotá in ruins and many people dead. Fighting spread to the countryside, where warfare and banditry continued until the mid-1960's. Colombians call this period *La Violencia* (The Violence). About 200,000 people were killed in La Violencia.

By 1957, conditions had become so unbearable that the Liberals and Conservatives agreed to form a *coalition* (joint) government. Between 1958 and 1974, they shared all political offices, and the leaders of each party alternated as the nation's president every four years. The coalition, known as the National Front, restored people's confidence in government and improved the economy.

Recent developments. In the mid-1960's, left-wing guerrilla groups began fighting against the government. They include the Revolutionary Armed Forces of Colombia (FARC) and the National Liberation Army (ELN). Both groups support establishing a Communist government.

In the 1970's, several Colombian organizations began to make huge profits from producing and selling illegal drugs, especially cocaine. The United States has been the main market for these drugs. In the 1980's and early 1990's, the Colombian drug trade was controlled by *cartels* (large groups of firms that dominate a business). The largest cartels were based in Medellín and Cali.

In the 1980's, the Colombian and U.S. governments began an effort to stop the drug trade. Colombia *extradited* (delivered) several drug traffickers to the United States for trial. In response, the cartels mounted a campaign of bombings, assassinations, and other terrorist acts. Right-wing paramilitary groups allied with the cartels carried out many killings. The cartels also made payoffs to the FARC and other leftist rebel groups in return for their help in guarding drug fields and traffickers. The rebels used the money to buy weapons, enlarge their armies, and carry out terrorist acts and kidnappings.

In the late 1980's, the government reached an agreement with some guerrilla groups. The peace process led to the adoption of a new constitution in 1991. The FARC and ELN, however, did not join the peace process.

In the mid-1990's, Colombian and U.S. law enforcement officials arrested or killed several cartel leaders, and the Medellín and Cali cartels were dismantled. Smaller organizations then took over the drug trade.

In the late 1990's, to fight leftist rebels, wealthy Colombians backed the formation of the United Self-Defense Forces of Colombia (AUC), a right-wing paramilitary group. The AUC killed many rebel soldiers and civilians.

Andrés Pastrana Arango was elected president in 1998 and soon began peace talks with the FARC and ELN. In 1998, he withdrew government forces from about 16,000 square miles (41,400 square kilometers) of territory in southern Colombia, giving the FARC control over the area. Despite his efforts, the FARC and ELN continued to enlarge their forces and launch terrorist attacks. In 2002, Pastrana broke off talks with FARC rebels and sent Colombian military forces back into the FARC-held area in southern Colombia. That same year, Alvaro Uribe Velez was elected president. William J. Smole

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Bogotá
Medellín
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Other related articles

Andes Mountains
Bolivar, Simón
Chibcha Indians
García Márquez, Gabriel José
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Panama (History)
Panama Canal
South America

Outline

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II. People
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- D. Education
- E. Clothing
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III. The land
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- C. The Eastern Plains

IV. Climate

V. Economy
- A. Agriculture
- B. Manufacturing
- C. Mining
- D. Service industries
- E. Energy sources
- F. Trade
- G. Transportation and communication

VI. History

Questions

For whom was Colombia named?
What is Colombia's leading crop?
What parts of Colombia have a chilly climate?
What is unusual about Colombia's coastline?
What three countries were once part of Colombia?
Where do most of Colombia's people live?
What is the ancestry of most Colombians?
Why is air travel very important in Colombia?
What was *La Violencia?*
Why can Colombian farmers grow many kinds of crops?

Additional resources

Bushnell, David. *The Making of Modern Colombia.* Univ. of Calif. Pr., 1993.
Morrison, Marion. *Colombia.* Rev. ed. Childrens Pr., 1999. Younger readers.

Colombo, *kuh LUHM boh* (pop. 683,000), is the largest city of Sri Lanka and the country's commercial center. A major seaport, Colombo lies on Sri Lanka's west coast (see **Sri Lanka** [map]). Most of the island's shipping passes through its harbor. Colombo is the center of Sri Lanka's tea, coconut, and cotton trade.

Colombo is an old city, founded before the mid-1300's. Scholars believe the city was originally known as *Kolamba,* a native term meaning both *port* and *leafy mango tree.* The name *Colombo* is the European version of this term. The Portuguese, who came in 1505, were the first Europeans to control Colombo. The Dutch occupied the city from 1656 to 1796 and erected a number of buildings that still stand. Perhaps the most impressive is the Wolfendhal Church, built in 1749. Colombo is also the home of the University of Sri Lanka. According to tradition, Buddha visited the temple of Kalaniya just outside Colombo. Commonwealth of Nations leaders set up the Colombo Plan there in 1950. Colombo served as Sri Lanka's capital from 1948 to 1982. Robert LaPorte, Jr.

Colombo Plan, *kuh LUHM boh,* is an international organization that provides assistance for economic and social development to countries of South and Southeast Asia. The assistance includes training and instruction, scientific research, consultative services, and financial aid. Its motto is *Planning Prosperity Together.*

The Colombo Plan has 25 member countries: Afghanistan, Australia, Bangladesh, Bhutan, Cambodia, Fiji, India, Indonesia, Iran, Japan, Laos, Malaysia, the Maldives, Mongolia, Myanmar, Nepal, New Zealand, Pakistan, Papua New Guinea, the Philippines, Singapore, South Korea, Sri Lanka, Thailand, and the United States. The Consultative Committee, which directs the program, has headquarters in Colombo, Sri Lanka.

Member countries within the region plan their own development programs with the advice of the committee. Voluntary contributions from member countries, nonmember countries, and international and regional organizations pay most of the costs of these programs.

The idea for the Colombo Plan originated at a meeting of the Commonwealth Foreign Ministers at Colombo in

January 1950. The Consultative Committee held its first meeting in May 1950 and published the principles of the plan in November. The Colombo Plan began operating in July 1951. Critically reviewed by the Colombo Plan Secretariat

See also **Australia** (The postwar years).

Colón, *koh LOHN* (pop. 59,840), is the third largest city in Panama. Only Panama City and San Miguelito have more people. Colón is located in central Panama, at the Atlantic Ocean end of the Panama Canal (see **Panama** [map]).

Colón is one of Latin America's busiest commercial centers. Since 1953, it has had a *free trade zone,* where merchants can import and export goods without paying *duties* (taxes). As a result, many trading vessels carry a variety of goods to and from Colón. Merchant ships from many nations also anchor at Cristóbal, just south of Colón, while waiting for passage through the canal. The main streets of Colón are often crowded with sailors, traders, and tourists. The city has many bars, nightclubs, and gambling establishments. Colón also has duty-free shops, which sell many products at low prices. Many Colón residents are descendants of people who came from Jamaica and other Caribbean islands to work on the Panama Canal, which opened in 1914.

Colón was founded as a result of the California gold rush. The city began in 1849 as the starting point of a railroad that carried people across the Isthmus of Panama. These people came by ship from the eastern United States, crossed the isthmus, then continued by ship to California. The town was first named *Aspinwall* after one of the railroad's builders. In 1890, the name was changed to *Colón,* the Spanish word for *Columbus,* to honor Christopher Columbus. Columbus had landed nearby in 1502. Nathan A. Haverstock

Colon, *KOH luhn,* is a mark of punctuation shown as :. Its primary function is to separate an introduction from what it introduces: a list, a long quotation, an illustration, or an explanation. A colon is most often used when the words preceding it form a complete sentence, as in the second sentence of this article. There are two exceptions. A colon ends the formal opening of a business letter, and it may be used after the main headings of an outline. Susan M. Gass

See also **Punctuation.**

Colon, *KOH luhn,* is a part of the large intestine. This muscular tube carries *chyme* (partially digested food) from the *cecum* (the first part of the large intestine) to the *rectum* (the last part). The colon is divided into four sections. The *ascending colon* extends upward on the right side of the abdominal cavity. It joins the *transverse colon,* which extends across the cavity to the opposite side. This section meets the *descending colon,* which passes down the left side and joins the S-shaped *sigmoid colon.* In human beings, the colon is about 5 feet (1.5 meters) long. It removes water and mineral salts from the chyme. Its strong muscles contract and relax and so push the residue toward the rectum. Mucus that covers the colon's inner surfaces lubricates them and eases the passage of chyme. Arnold Gerald Coran

Related articles in *World Book* include:

Colitis	Dysentery
Colon cancer	Human body (Trans-Vision)
Colostomy	Intestine
Diverticulitis	

Colon cancer is the common name for an uncontrolled division of cells in the large intestine. Many doctors prefer the term *colorectal cancer,* because the disease most often affects the main part of the large intestine, or *colon,* and the last part, called the *rectum.*

Colorectal cancer is one of the most common cancers in North America and Europe, but it is relatively rare in Asia and Africa. The difference may be due to regional variations in diet. Studies show that people may help avoid this disease through a diet that is low in fat and rich in fruits and vegetables. Other studies suggest that small doses of aspirin at least every other day may also help prevent colorectal cancer.

Conditions that inflame the intestine, such as ulcerative colitis, increase a person's risk of developing colorectal cancer. People who have family members with that type of cancer also have an increased risk. Scientists have identified defects in certain genes that are associated with some rare forms of the disease. They believe that many common types of colorectal cancer also involve genetic abnormalities. Cancer often arises in *polyps,* small noncancerous growths in the intestine. A tendency to develop polyps is probably influenced by genes, as well.

In its early stages, cancer in the right side of the large intestine may not cause noticeable symptoms. Cancer that develops in the left side of the colon or the rectum often affects an individual's bowel habits. People should see a doctor if they experience a change in the frequency of their bowel movements or pain while having a movement. *Stools* (solid body wastes) that look unusually narrow or appear to contain blood should also be evaluated.

Many doctors recommend that middle-aged people have routine tests for colorectal cancer. Doctors often give such patients special kits to collect tiny samples of stool as part of their regular checkups. Laboratories test these samples for microscopic amounts of blood, which may indicate cancer. Periodic examinations with special instruments that enable doctors to see inside the intestine are also recommended. During these examinations, doctors can obtain samples of suspicious tissue, which can be checked under a microscope for cancer cells.

Most patients whose cancer is confined to the intestine have the growth surgically removed. They may also receive radiation therapy or *chemotherapy* (treatment with drugs). These patients have an excellent chance of being cured. Patients whose cancer has spread beyond the intestine usually have surgery, supplemented by radiation therapy or chemotherapy.

Marc B. Garnick

See also **Cancer; Intestine.**

Colonial architecture. See Georgian architecture.

Colonial Dames of America, National Society of the, is a society of women organized in 1891 to create an interest in American colonial history. Membership is by invitation and is based on descent from some ancestor who came to an American colony before 1750, and who, by distinguished services, contributed to the founding of the nation. The society was organized in Philadelphia. It has about 16,000 members. Headquarters are in Washington, D.C. Critically reviewed by the National Society of The Colonial Dames of America



The Marketplace at Jamestown 1619 (1959), oil on canvas by Sidney King; Jamestown-Yorktown Foundation, Williamsburg, Virginia

The first permanent English settlement in America was established in 1607 at Jamestown, Virginia, *above.* Through the years, large numbers of settlers from all levels of society left Europe behind for the chance at a new life in the American Colonies.

Colonial life in America

Colonial life in America. The story of the American colonists tells of the men, women, and children who left behind the Old World of Europe for a new life in North America. It describes the everyday life of the settlers in the communities they developed. It also tells of the meeting of cultures, as Europeans and Indians came into contact with each other. The British American colonial period began in the late 1500's with English attempts to settle Newfoundland and Roanoke Island, off the coast of what is now North Carolina. It ended with the start of the Revolutionary War in America in 1775.

Many of the colonists came to North America from England, Scotland, Wales, and Ireland. But the New World attracted settlers from France, Germany, the Netherlands, Sweden, and other European countries as well.

The majority of settlers came to the colonies for economic opportunity or to avoid political and religious unrest at home. However, not all colonists arrived voluntarily. The slave trade brought large numbers of people from Africa against their will. Some orphans were sent from England to America under labor contracts over which they had no control. Some English convicts were transported to the colonies to become servants.

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When the Europeans arrived in North America, the continent was already home to many groups of Native Americans with many different cultures. The Indians were originally helpful to the colonists, and trade developed between the two groups. This trade changed the society of both the Indians and the settlers. The Indians strongly resisted the settlers' attempts to claim more and more Indian land. From time to time, fighting broke out between the colonists and the Indians. Eventually, the colonists pushed most of the Indians to the west.

Among the European colonial powers, the English arrived late in the Americas. By the time England colonized the New World, Spain and Portugal had already staked their claims there. Spain's colonial empire, established during the 1500's, stretched from South America to California. It also included Cuba, several other islands in the Caribbean Sea, and Florida. Portugal controlled what is now Brazil. In eastern North America, the English, French, Dutch, and Swedes competed for land and riches. For most of the colonial period, France claimed Canada and the Mississippi Valley. By the end of the period, the British controlled nearly all of North America from the Atlantic Ocean to the Mississippi River. They also held several Caribbean islands.

The Spanish and French in North America were interested chiefly in sending furs, gold, and other riches back to Europe. They also wanted to convert the Indians to Roman Catholicism. The early French and Spanish settlements served as outposts for soldiers and traders

and as missions run by priests. The English colonies, on the other hand, were settled by people from many walks of life who wanted to set up permanent homes.

The English colonists built farms that grew crops which were sold overseas. They built schools and churches and founded thriving port towns. By the mid-1700's, the colonists had a general standard of living equal to the wealthiest European nations. Also by then, the colonists had developed strong forms of self-government.

This article discusses the 13 English colonies that became the original United States. For the history of each of the Thirteen Colonies, from settlement to statehood, see the separate *World Book* articles on the states, such as **Maryland** (History). See also the article **United States, History of the** (The colonial heritage). For information on other colonial settlements in North America, see **Canada, History of; Mission life in America; New France; New Netherland;** and **New Sweden.** For a history of colonies in Central and South America, see **Latin America** (History).


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Signe of the Bul-head.
1609.

Bettmann Archive

Advertising helped sell shares of the joint-stock companies that developed England's early settlements in the New World.

Why the colonists came to America

The first permanent English settlement was founded at Jamestown in 1607. By 1733, the heart of the British Empire in the New World consisted of 13 colonies along the Atlantic coast of North America. Most of these colonies were founded by private *joint-stock companies* or individuals who had received permits from the English monarch to colonize lands claimed by England. Joint-stock companies, the forerunners of modern corporations, were companies that obtained funds to carry on business by selling shares of stock to individuals.

The companies and individual investors hoped to make a profit from their colonies and to expand English trade and industry. They advertised for settlers and pointed out that fertile land and valuable resources were available in the New World. The advertisements attracted many people who were willing to move to the newly established colonies.

People had many reasons for leaving England and the rest of Europe and making the long journey across the Atlantic Ocean. Landowners claimed land formerly available to small farmers, thus forcing some to leave. Children of small farmers saw little economic opportunity and moved to towns to look for work. Wars and revolts in Europe made people want a quiet home. Many rulers insisted that all people living in their country attend the same church. They persecuted those who could not agree. For example, more than 100,000 Protestants known as Huguenots fled Roman Catholic France for other countries.

Most of the settlers came from England. The colonists also included many people from Scotland. People of Scottish ancestry who had settled in the northern part of Ireland also came in large numbers. These people were known as *Scotch-Irish.* Other people who decided to head for the colonies came from France, Germany, the Netherlands, Sweden, and other European countries.

Economic reasons. Rising unemployment, several harvest failures, and other economic conditions in England influenced the decision of many colonists to migrate to the American Colonies. Many people looked to the New World as a place where they could buy land or find employment and eventually better themselves.

Of all the economic attractions of the New World, land was probably the greatest. Many settlers came to America because they were offered land free or at low cost. Land ownership made people independent and promised a better standard of living for themselves and their children. People who owned land in the colonies were called *freeholders,* and they had certain rights and duties in the community. Male freeholders generally could vote.

Land was distributed in various ways in the colonies. Technically, the colonies belonged to the English monarch. The king or queen issued permits called *charters* giving an individual or group the right to establish a colony. Investment companies received some charters. Individuals or groups called *proprietors* got others.

In Virginia, shareholders of the original joint-stock company included both settlers who came to Virginia and people who stayed in England and invested money. Several years after founding the colony, the company gave each settler 100 acres (40 hectares) of land to develop. A system of *headrights* was also established in the colony. Under this system, anyone could claim 50

acres (20 hectares) of free land by paying for their own transportation or that of other settlers.

In the colonies to the north, often called the New England Colonies, grants of land were generally given to groups of settlers who wanted to form a new community, or *town*. Some of the land was reserved for public use. The rest was divided among the settlers, who received lots for a house, a garden, and fields to farm. The town became a small company that governed itself.

In the other colonies, extremely large grants of land were sometimes given to individuals who had political power. These owners sold or rented sections of their land to people who wanted to have their own farms. In other cases, colonies offered cheap or free land to attract settlers.

Religious and political reasons. Some of the colonists, beginning with the Pilgrims in 1620, came to the New World to create communities where they could worship in their own way. Throughout the colonial period, many groups headed for the colonies to escape persecution for their religious beliefs. Among those religious groups were Quakers and Roman Catholics from England, Huguenots from France, Moravians from Germany, and Jews from throughout Europe.

Before the arrival of the European settlers

When the European colonists arrived in the New World, they found a rich and diverse land. The eastern coastal region where they settled consisted mainly of a forested plain that stretched from the Atlantic Ocean to the Appalachian Mountains. Major rivers and bays cut through the plain, which broadened in the south. Many of these rivers provided a means of travel to the interior.

Fish were plentiful along the seacoast and in the inland waters. Many kinds of animals lived in the forests. They included deer, rabbits and other small game, and birds, such as ducks and geese.

The area that would later become the Thirteen Colonies was also home to more than 500,000 Indians. The tribes in the north included the Massachusett, Pequot, and Wampanoag. Among the groups in the central part of the region were the Delaware, the Susquehannock, and the nations of the powerful Iroquois League—the Cayuga, Mohawk, Onondaga, Oneida, and Seneca. Farther south lived the Catawba, Cherokee, Creek, and other tribes.

The Indians of eastern North America generally lived in villages near fields where they grew corn, squash, and beans. They also hunted and fished, and gathered wild plants, nuts, and berries.

For more information on the way of life of the Indians of eastern North America, see **Indian, American** (Indians of the Northeast; Indians of the Southeast).

Early English settlements

During the 1580's, the English made several unsuccessful attempts to establish a colony in North America. For example, members of an English expedition landed on Roanoke Island off what is now North Carolina in 1585 but returned to England the following year.

In July 1587, another group of English men and women landed on Roanoke. They were led by John White, who had been a member of the earlier Roanoke settlement. In August, White sailed back to England for supplies. War between England and Spain prevented him from returning until 1590. By the time White finally made it back to Roanoke, all the colonists had disappeared (see **Lost Colony**).

War in Europe delayed further colonization efforts until 1606, when two groups of English investors formed the Virginia Company of London and the Virginia Company of Plymouth, also known as the London Company and the Plymouth Company (see **London Company; Plymouth Company**). These companies together received a charter from King James I to found one colony apiece. One colony was to be established somewhere between present-day New York and the Carolinas, and the other was to be set up between the Potomac River and present-day Maine. A group from each company arrived in the New World in 1607. The Plymouth group's efforts in the north collapsed, but the London Company's settlement at Jamestown held on.

Jamestown became the first permanent English colony in America. The 104 original colonists—all men and boys—established a settlement on a peninsula in what is now the James River on May 24, 1607. The day was May 14 on the calendar then in use. The colonists planned to explore Virginia and trade with the Indians. The London Company investors hoped to follow the example of the Spanish colonies and make a quick profit from gold or other trade goods. But gold was not found. Instead, the company had to refinance with a lottery, new issues of stock, and a royal subsidy. About 1614, the colonists developed tobacco as a successful *cash crop*—that is, a crop grown for sale rather than for the colonists' own use. Even then, the company did not become successful.

Survival of the Jamestown settlement was doubtful for the first 20 years. Swampy land, bad water, and inadequate food and shelter contributed to high death rates. Disorganized leadership also added to their problems. About two-thirds of the original group soon died of disease and starvation. The men and women who came in 1608 and 1609 also suffered serious hardships. So many of the colonists died during the winter of 1609-1610 that this period became known as "the starving time." Only the arrival of ships with supplies and more settlers in

Important dates in the early European settlement of North America

1565 The Spanish explorer Pedro Menéndez de Avilés founded St. Augustine. This Florida city is the oldest permanent settlement established by Europeans in what is now the United States.

1607 About 100 colonists founded Jamestown, the first permanent English settlement in North America.

1612 Colonial leader John Rolfe became the first colonist to cultivate tobacco. By about 1614, tobacco had become an important cash crop for the Jamestown settlement.

1614 Rolfe and Pocahontas, the daughter of the Indian leader Powhatan, were married. The event was marked by a truce between the colonists and the Indians.

1619 The first black Africans brought to the North American mainland came to Jamestown as indentured servants.

1620 The Pilgrims founded Plymouth Colony, the second permanent English settlement in North America.

1624 The Dutch established the settlement of New Netherland.

1638 People from Sweden established New Sweden.

1682 The French explorer René-Robert Cavelier, Sieur de La Salle, claimed the Mississippi River Valley for France and named it Louisiana.

1610 saved the colony from abandonment.

The colonists also faced problems with the Indians of the region. When the colonists arrived in Virginia, the area was home to about 18,000 Indians. Over 30 of the tribes in the region were united in a confederacy under the leadership of Wahunsonacock, whom the colonists called Powhatan. The English also referred to the Indian tribes of the confederacy as the Powhatan. At first, the settlers and Indians got along. But by 1609, fighting had broken out between the groups, largely because the settlers tried to seize food from the Indians.

In 1613, the English took Powhatan's daughter Pocahontas hostage. A year later, after Pocahontas converted to Christianity, she and the colonist John Rolfe married. The colonists and Indians marked the occasion with a truce. That truce lasted until 1622, when the Indians, under a new leader, launched a surprise attack on Virginia. The Indians, who hoped to drive the English away, killed about 350 colonists. But the colony managed to survive the attack.

In spite of the many hard times, Jamestown endured. The London Company took a number of steps to persuade the colonists to stay and to attract more settlers. In 1619, for example, the company set up an elected assembly in the colony. This was the first elected representative assembly in the New World. Also in 1619, the company made special efforts to recruit women to go to the colony.

In 1624, the London Company went bankrupt. King James I then took over direct control of Virginia. See **Jamestown; Virginia** (History).

Plymouth Colony. The English established their second permanent settlement on mainland North America in 1620 in the area now called Cape Cod, Massachusetts. Most of the original settlers of the colony, called Plymouth Colony, were Separatists. Later Americans called this group "Pilgrims." The Separatists had cut ties with the Church of England, also known as the Anglican Church. Before coming to America, the Separatists had moved to the Netherlands to escape persecution.

The Pilgrims faced many hardships in the New World. Hunger and sickness killed half the original settlers during the first year. In the spring of 1621, however, a Patuxet Indian named Squanto taught them how to plant corn and showed them where to fish. In the autumn, the colonists celebrated their first harvest by sharing a meal with their Indian friends. This feast is now referred to as the first New England Thanksgiving. However, hunger, debt, and sickness continued to trouble New England for a decade.

The Plymouth colonists maintained friendly relations with the local Indians. In 1621, the settlers and Indians signed a peace treaty that lasted more than 50 years.

The Dominion of New England controlled Plymouth from 1685 to 1689. In 1691, the colony became part of the Massachusetts Bay Colony. See **Plymouth Colony; Pilgrims.**

Development of the Thirteen Colonies

English expansion. Before 1649, when King Charles I was executed as a result of the English Civil War, England established several additional colonies on the North American mainland. The Massachusetts Bay Colony was founded in 1628. Some colonists from the Massachusetts Bay Colony later moved away and established settlements in Connecticut, New Hampshire, and Rhode Island. Maryland was established in the Chesapeake region in 1634.

From 1649 to 1660, England did not have a monarch (see **England** [The Civil War]). During that period, the nation did not begin any new colonies in North America. After Charles II became king of England in 1660—an event known as the Restoration—he granted charters for areas that would later include the colonies of Delaware, New Jersey, New York, Pennsylvania, and North and South Carolina. These colonies are sometimes called the *Restoration Colonies.* Some of these colonies were formed from New Netherland, which the English seized from the Dutch in 1664. The original Dutch settlement in New Netherland dated back to the 1620's.

During the 1700's, the English established several more colonies. For example, the first British settlers arrived in Georgia in 1733. Britain (now the United Kingdom) and France and their allies fought a series of wars ending in 1763. By that year, Britain had gained control of Canada, Florida, and the Ohio Valley. However, only Georgia became part of the 13 original United States.

Geographic divisions. Historians often divide the Thirteen Colonies that would become the original states into four geographical groups. They are (1) the New England, or Northern, Colonies; (2) the Middle Colonies; (3) the Chesapeake Colonies; and (4) the Southern Colonies. Some historians consider the Chesapeake Colonies to be part of the Southern Colonies.

The New England Colonies were Connecticut, Massachusetts, New Hampshire, and Rhode Island. These colonies had small farms and compact towns. The generally rocky soil of the New England region discouraged most large-scale agriculture, but the area was rich in timber and fish.

The Middle Colonies were Delaware, New Jersey, New York, and Pennsylvania. These colonies had larger farms than New England, and they produced surpluses of corn, wheat, and other agricultural products for export. Philadelphia became the bustling trade center of the Middle Colonies.

The Chesapeake Colonies consisted of Maryland and Virginia. Large farms and plantations in these colonies grew wheat and tobacco as cash crops. Life was more rural in the Chesapeake Colonies than in those farther north, and towns developed more slowly.

The Southern Colonies included Georgia and South Carolina. North Carolina, though geographically a Southern Colony, was economically and culturally similar to the Chesapeake Colonies. For example, North Carolina, like Maryland and Virginia, produced tobacco and wheat. Plantations in South Carolina and Georgia grew

The Thirteen Colonies and the dates of their first permanent settlements

Colony	Date	Colony	Date
Virginia	1607	Delaware	1638
Massachusetts	1620	Pennsylvania	1643
New Hampshire	1623	North Carolina	c. 1653
New York	1624	New Jersey	1660
Connecticut	1633	South Carolina	1670
Maryland	1634	Georgia	1733
Rhode Island	1636		

rice and *indigo*. Indigo is a plant that produces blue dye for coloring textiles. The colonies of South Carolina and Georgia each had a thriving port town to serve them—Charles Town (now Charleston), South Carolina; and Savannah, Georgia.

Changes in colonial control. The 13 English colonies began as either *corporate colonies* or *proprietary colonies*. Corporate colonies had a charter granted by the English monarch to stockholders. Proprietary colonies were owned by an individual proprietor or by a small group of proprietors under a charter from the monarch. Connecticut, Massachusetts, Rhode Island, and Virginia were founded as corporate colonies. The other nine colonies were established as proprietary colonies.

In 1624, the English monarch began to change the colonies into *royal colonies*. Such colonies were under the direct control of the monarch. By the end of the colonial period, only Connecticut and Rhode Island remained corporate colonies, and just Delaware, Maryland, and Pennsylvania were still proprietary. The other eight colonies had become royal colonies.

Population growth. The population of the colonies increased rapidly during the late 1600's and early 1700's. By 1700, about 250,000 people lived in the English colonies. By 1775, the population had grown to about $2\frac{1}{2}$ million. Virginia was the largest colony. Its population of about 450,000 was nearly evenly divided between people of European descent and those of African ancestry. Massachusetts and Pennsylvania each had about 250,000 people. The Chesapeake and Southern colonies had the largest population, but the biggest cities were in the Middle and Northern colonies.

Colonial growth was the result of both natural increase and immigration. Large numbers of immigrants came to North America throughout the colonial period. By the early 1700's, the colonists included a growing number of Scotch-Irish and Germans, who tended to settle in the back country, away from the developed areas along the coast. Imports of enslaved Africans also increased. All colonies had some slaves, but the Chesapeake and Southern colonies had the largest number. By 1710, a majority of the population of South Carolina was black.

Commercial expansion led to the rapid development of colonial port cities. These cities served as centers for crafts and for imports and exports for their region. In 1775, the largest colonial cities, in order of size, were Philadelphia; New York City; Boston; Charles Town (now Charleston), South Carolina; and Newport, Rhode Island. Philadelphia had a population of about 40,000, and New York City was home to about 25,000. Approximately 16,000 people lived in Boston, which had been the largest colonial city until the mid-1700's. Charles

The Thirteen Colonies in 1763

This map shows the 13 British colonies that became the United States. Their population grew to nearly 2 million in a little more than 150 years after a small band of English settlers established the first colony at Jamestown.



New England Colonies

Middle Colonies

Chesapeake Colonies

Southern Colonies

Proclamation line of 1763

Boundaries of colonies

WORLD BOOK map



Bettmann Archive

The Puritan settlement of Boston became the chief city in New England during the colonial period. It was named the capital of the Massachusetts Bay Colony in 1632 and was the largest city in all the colonies until the mid-1700's. This engraving shows Boston in the mid-1600's.

Town had a population of about 12,000, and Newport had 11,000 people.

Colonists and Indians

As colonial settlement expanded, so did trade and war with Indians. Indians taught the colonists to grow such crops as corn and tobacco. Periodically, the colonists and Indians fought bitter wars as colonists tried to eliminate nearby tribes, or Indians resisted further expansion into their lands. Indians sought allies among other tribes and European nations. As a result of these alliances, Indians became involved in the wars that European powers fought in North America from 1689 through the Revolutionary War.

Effects of contact on the Indians. The settlers introduced the Indians to metal pots and tools, textiles, and other goods. The colonists traded these products with the Indians in return for hides and furs, chiefly deerskins and beaver pelts. Many European traders lived in Indian villages and married Indian women. Some Indians living near or among colonists worked as day laborers or sold baskets and other crafts.

Through the years, many Indians began to depend on European textiles, tools, and pots obtained in the fur trade. As a result, their way of life began to change. Previously, these Indians had generally killed only as many animals as they needed for food, clothing, or shelter. But the growing dependence on trade goods led them to hunt and trap for commercial purposes rather than for personal or tribal survival. Game became scarce, and free-roaming colonial livestock ruined Indian fields. Some Indians moved west. Others bought food from whites. The expanding fur trade also led to greater tensions among tribes as they competed for furs to supply the colonial traders.

The coming of the colonists also changed Indian ways of life in other ways. Missionaries who set up towns and missions for Indians challenged traditional Indian culture and beliefs. As a result of the missionary efforts, some Indians converted to Christianity and adopted European customs.

In addition, contact with the settlers exposed Indians to new diseases for which they had no immunity. Many Native Americans—in some cases, whole villages—died from smallpox and other diseases the Europeans carried into the New World.

The struggle for land. Although charters from the English monarch gave individuals or groups the right to establish colonies in eastern North America, the settlers had to obtain the land itself from the Indians living there. They generally did so by making treaties for the land or by buying it directly. Later, some Indian lands

A View of Bethlehem (1757), colored engraving by Nicholas Garrison; The New York Public Library

Farms in the Middle Colonies benefited from fertile soil and a favorable climate to produce large quantities of corn, wheat, and other agricultural products. This colored engraving shows an early view of the settlement of Bethlehem, Pennsylvania, and its surrounding countryside.



Granger Collection

A typical plantation in the Chesapeake and Southern colonies included a fine mansion, *foreground.* Behind the mansion were a number of buildings, including a kitchen, a laundry, a smokehouse, a coach house, barns, and slaves' cabins.

were taken by force, fraud, and other means.

The Indians and colonists had different views about the nature of land ownership. In "selling" land to the colonists, most Indians believed they were giving the settlers only the right to use the area. The Indians expected to keep farming and hunting on the land themselves. The colonists, on the other hand, believed that land treaties and purchases gave them exclusive and permanent rights to the land. Disputes over land rights and ownership led to fighting between Indians and colonists. Many of these conflicts consisted of isolated Indian raids on towns and on cabins in the back country, as well as attacks by colonists on Indian villages.

Additional fighting occurred as colonies tried to expand farther into Indian territory. The colonies claimed they needed more land for their growing populations. However, many tribes objected to giving up any more land, and a number of bitter wars between the colonists and Indians resulted.

Some tribes also took sides in the series of four wars that France and England fought in North America from 1689 to 1763. In the last of the wars, the one called the French and Indian War (1754-1763), for example, the Catawba fought on the side of England. See **Indian wars; French and Indian wars.**

After their victory in the French and Indian War, the British controlled nearly all of North America from the Atlantic Ocean to the Mississippi River. In an effort to prevent more Indian wars, Britain issued the Proclama-

Important dates in relations between colonists and Indians

1616 A smallpox epidemic nearly wiped out Indians along the New England coast.
1621 Squanto, a Patuxet Indian, showed the Plymouth colonists how to plant corn.
1626 Peter Minuit, a Dutch colonial governor, purchased the island of Manhattan from the Indians. He paid with trinkets worth about 60 Dutch guilders, or $24.
1675-1676 The Wampanoag Indians and several other tribes led by King Philip (Indian name Metacomet) fought King Philip's War to resist colonial expansion in New England. The Indians were eventually defeated.
1763 The British defeated the French for control of eastern North America. Following their victory, the British issued the Proclamation of 1763, which outlawed colonial settlement west of the Appalachian Mountains. That region was to be reserved for the Indians.
1768 Northern Indian Commissioner Sir William Johnson signed the Treaty of Fort Stanwix with the Iroquois. Much of the land between the Tennessee and Ohio rivers was thereby acquired for future colonial settlement.

tion of 1763. This order reserved the territory west of the Appalachian Mountains for the Indians and barred colonial settlement there. A number of angry colonists, eager for new land, refused to obey the proclamation.

Some Indian tribes adopted Europeans or other Indians captured during wars. This practice was especially applied to women and children. Some captives married Indians and had families. At the end of each Indian war, the colonies required the Indians to return their captives. A number of prisoners, however, chose to stay with the Indians. In some areas, Indians captured by colonists or by opposing tribes were sold as slaves.

The structure of colonial society

Colonial society was divided into several social classes. Class helped determine much of people's lives, from their political rights to what they wore or where they sat in church. In addition, some laws applied to one class and not to others.

The gentry formed the wealthiest, best-educated, and most influential class. Some members of the gentry owned large farms or plantations. Others were merchants, doctors, lawyers, or ministers. The most prosperous skilled craftworkers, such as goldsmiths, also belonged to this class. By the mid-1700's, the gentry lived in large houses and owned elegant furniture and carriages.

The gentry held most leadership positions in colonial communities. Many of the men held public office. Gentry women did many household tasks themselves, but they also supervised servants. Both men and women had time for visiting and for the arts and leisure.

The middle class, or "middling sort," farmed smallholdings, ran shops and small businesses, or worked at ordinary skilled crafts, such as shoemaking or cabinetmaking. Both men and women in middle-class families contributed to the family income. Women produced candles, cheese, cloth, soap, and other goods for the family and for sale. Many women also helped men in the family shops. Some women ran their own small businesses. Middle-class men could vote, and some held minor public offices.

The lower class, or "lower sort," included apprentices, day laborers, sailors, indentured servants and other servants, and slaves. Most members of the lower class did not own any property, and most could not read or write. They were not allowed to vote. Many members of the lower class moved from place to place frequently in search of work and better opportunities. Many of the poor were women who took in laundry, sewing, or spinning to support their families.

Indentured servants formed a special group within the lower class. Most indentured servants signed a contract to work for several years to pay for their passage to the New World. A majority were young men between 15 and 24 years old who were looking for jobs and a better life. However, about one-fourth of the servants were women, and some were children. Most children who worked as indentured servants were orphans or came from families that were unable to support them. Some convicts and debtors were also sent to the colonies.

After 1720, many people came as *redemptioners.* Redemptioners were a special kind of indentured servant. They agreed to raise the money for their trip to America after arriving there. If they failed to raise the required sum within a stated period, they could be sold into service by the shipmaster.

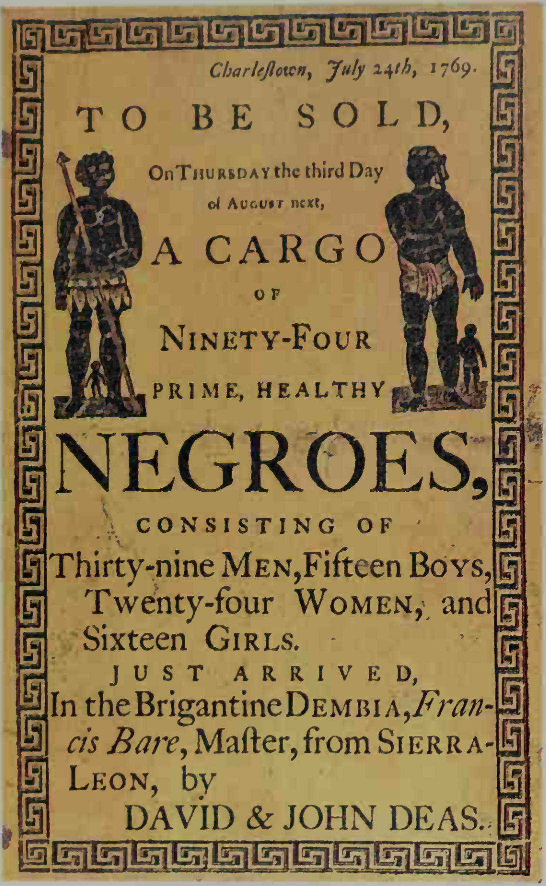
Most indentured servants worked as agricultural laborers, but some were highly skilled craftworkers. Masters provided indentured servants with food, clothing, and housing. Masters typically gave servants *freedom dues*—that is, new clothes or tools—at the end of the contract.

Slaves. Most slaves or their ancestors came from Africa. However, some Indians were also forced into slavery. The first group of black Africans to be brought to the North American mainland arrived in Jamestown in 1619. At first, black Africans worked as indentured servants who would eventually be free. But by the mid-1600's, a series of laws known as the *slave codes* had established slavery and kept the Africans in bondage for life—unless their owners chose to free them.

Slaves had few rights, and they generally could not testify in court against whites. As a result, even when owners brutally mistreated slaves, the owners received little or no punishment. The slave codes made it illegal for slaves to travel without permission or to carry weapons. They also set harsher punishments for slaves than for free people for certain crimes. According to the codes, owners could buy and sell slaves much as they would other property. The codes also established the legal status of the children of slaves. For example, children of mothers who were slaves were considered under the law to be slaves themselves—no matter who their fathers were.

Most slaves worked as field hands on farms with fewer than 20 slaves. Some learned skilled crafts or served in households. Every colony had slaves, though most slaves lived in the Chesapeake and Southern colonies.

The colonies had a number of small communities of free blacks. Some free blacks had free mothers. Others had been favorites of their owners and had been set free. Free blacks had to follow some of the laws that applied to slaves. Sometimes, free blacks had to prove they were free. If they failed to offer such proof, they



Granger Collection

The slave trade brought large numbers of people from Africa to America against their will. This poster advertised a slave auction in Charles Town (now Charleston), South Carolina.

could be arrested and sold as runaway slaves. Most free blacks were part of the lower class, but a few owned land or were skilled craftworkers. A small number were educated.

Government and law enforcement

Colonial government. All the colonies had a governor, a legislature, a governor's council, and a court system. In royal colonies, the monarch appointed the governor. In proprietary colonies, the proprietors did so. In the corporate colonies of Connecticut and Rhode Island, the voters elected the governor.

All the colonies except Pennsylvania had *bicameral* (two-house) legislatures. Pennsylvania had a *unicameral* (one-house) legislature. The colonial legislatures generally were known as assemblies, though some had other names. For example, Massachusetts called its legislature the General Court, and the lower house of Virginia's legislature was known as the House of Burgesses.

In all the colonies except Pennsylvania, the governor's council served both as an upper house of the legislature and as the cabinet of the governor. Voters elected the members of the lower house in all the colonies. They elected representatives to the upper house only in Connecticut and Rhode Island. In Massachusetts, the lower house chose the upper house. In the other 10 colonies, the governor or proprietor chose the council.

Colonial legislatures debated issues and elected officers to preside over their meetings. They passed laws and could tax the people. The governor could veto any laws passed by the legislature. The governor also had the right to call elections and to call together and dismiss the legislature.

The British Parliament passed some laws for the colonies, especially ones regulating trade. It also created a postal system and certain courts for the colonies. British officials reviewed all laws passed by colonial legislatures in royal and proprietary colonies. These officials could *disallow*—that is, reject—laws that they considered to be contrary to English law. Only about 5 percent of colonial laws were disallowed. However, even these few acts of disallowance caused resentment in the colonies. In some cases, decisions of colonial courts were appealed to England.

Local government. In New England, the main unit of local government was the town. Voters at town meetings chose most local officials and decided on local laws. All adult residents of a town could attend a town meeting, but only those men who met certain qualifications could vote. Town governments collected taxes, built roads and bridges, and organized the militia.

In most areas outside New England, the county was the chief unit of local government. Towns with charters from the assembly could run their own affairs. County courts performed the functions of local government, including setting taxes. The courts also handled matters of land ownership, wills, and other legal cases. Justices of the peace, appointed by the governor, together formed the county courts. Other county officials included county clerks and sheriffs.

In many areas of the South, parishes were units both of the Church of England and of county government. The parishes elected church officials known as *vestrymen* to take care of the poor and to set taxes.

Voting and other rights. Not everyone had the same rights in the colonies. Single adult women had the same rights as men except for voting. Married women,

Important dates in colonial government

1619	The House of Burgesses met in Jamestown. It was the first elected legislative assembly in America.
1620	The *Mayflower Compact* was signed by Pilgrims aboard the *Mayflower,* the ship that brought them to the New World. The compact became the first agreement for self-government enacted in America and served as the basis for the government of the Plymouth Colony.
1639	The Connecticut Colony adopted the Fundamental Orders as its law. The orders gave voters the right to elect government officials. They are regarded by some scholars as the first written constitution.
1641	Massachusetts Bay Colony set down its first code of laws in a document known as the *Body of Liberties.*
1774	The First Continental Congress, a convention of delegates from the American Colonies, met in Philadelphia. The Congress grew out of a desire for unity that had spread throughout the colonies. The meeting set forth the position of the colonies toward taxation and trade.
1775	The Second Continental Congress met in Philadelphia. It took on many governmental duties and helped unite the colonies against Britain.



An engraving from *A Popular History of the United States;* Library of Congress

America's first representative legislature, the House of Burgesses, met at Jamestown in 1619. Its elected members, with the governor and council, made the laws of Virginia.

however, usually did not have independent control of property. Some women kept control of property through marriage contracts or trusts. Slaves could not sue or be sued. Slave codes limited travel for slaves and set harsher penalties for some crimes.

Not all adult colonists were permitted to vote. Qualifications for voting varied among the colonies, though generally they set property ownership as a requirement. Depending on the colony, this requirement could be satisfied by owning a town lot or a small farm, or by holding a long-term lease. In some cases, people could qualify to vote by paying taxes of a certain amount. Slaves could not vote in any colony. Laws and custom usually kept women from voting as well.

Some requirements restricted voting to members of certain religious faiths. In the 1600's, New England voters had to be members of the Congregational Church. In royal colonies, voters needed occasionally to attend the Church of England. In practice, this policy kept Jews and Roman Catholics from voting. By the 1700's, in practice, most adult white males could vote at some point in their lives.

People voted in person, often by announcing their vote to officials. There were no political parties or organized campaigns. Some candidates, however, hosted social gatherings and provided food and drink for voters. Some colonies had groups of men who worked together in politics and elections in much the same way later political parties would.

The gentry held most elected positions. Many offices paid no salary, and only people with money could afford to serve. The gentry saw public office as a duty and a right. Ordinary voters usually agreed that leaders should come from the gentry class.

Crime and punishment. Constables and sheriffs arrested suspects, kept order, and enforced court orders. Jails were used mainly to hold people for trial or until they paid their debts. Local courts and juries ruled on cases involving slaves and on minor offenses, such as drunkenness and disturbing the peace. Certain high courts tried people accused of a major crime, such as murder or treason.

Punishment was direct and swift. Men and women convicted of adultery, gossip, slander, petty theft, drunkenness, or disturbing the peace faced fines, whipping, or *shaming.* Shaming consisted of subjecting a person to public disgrace.

Common forms of shaming included the *pillory, stocks,* and *ducking stool.* The pillory and stocks stood in a town square. They were wooden frameworks with holes cut in them. In a pillory, the holes held the arms and head of the victim. In the stocks, the holes held the victim's legs, and sometimes also the arms. Prisoners were locked into the holes for a certain time. The ducking stool was a chair attached to the end of a long plank extended from the bank of a pond or stream. The victim of the punishment was tied securely to the chair and *ducked* (plunged) into the water several times. See **Ducking stool; Pillory; Stocks.**

Punishments given for the same type of crime often depended on who the criminal was. A member of the lower class might receive a harsher punishment than a

middle-class person, and a woman might receive a shaming punishment for committing a crime for which a man would pay a fine. People convicted of burglary, counterfeiting, murder, piracy, rape, or treason faced death by hanging.

Colonists at home

Colonial households were places of work, play, and family life. They were not private places. Rooms served many purposes. Neighbors walked in and out. Colonial households often included servants, slaves, and visitors. Families in the colonies generally had more children than those in England. The average was seven children. Many households included stepchildren, grandparents, aunts, or cousins. Families of slaves did not always live together. Slave children lived with the mother, but the father sometimes lived apart.

The father was the head of the colonial household. The mother was expected to be his companion and helper. When the father was absent or ill, the mother could represent the family in financial dealings and other matters. She was supposed to obey her husband, and he was to respect her. Children, servants, and slaves were also expected to obey the head of the household. All members of a household were supposed to work for its well-being.

Houses. When the colonists arrived in the New World, they at first made temporary shelters. Early colonists built one- or two-room huts of wood and mud. The settlers later began to build dwellings that resembled those they left behind in England. However, the colonists adapted building design and construction to local conditions and materials. For example, many colonists near the Appalachians used local limestone for their homes, and some in New England used rocks from the fields as their building material. By the 1700's, many wealthy families built their homes of brick.

The chief building material throughout the colonies was wood, which was plentiful in the eastern forests. Most early permanent dwellings were simple cottages with walls made of shingles or planks and roofs of thatch or shingles. Houses made of planks became known as *frame houses*. Most windows were small.

Houses in New England commonly had two rooms in front with a third running across the back. Many homes had a second floor over the front two rooms. In some homes, a brick or stone central chimney served two fireplaces that stood back to back. Most houses in the Chesapeake and Southern colonies consisted of one or two rooms connected by a central hallway. Above these rooms were lofts that were used mainly for sleeping. Fireplaces stood at two opposite ends of these houses. Chimneys stood outside the framework of most homes.

Many houses in the Delaware River Valley and the Hudson River Valley were of Scandinavian or Dutch design. The Swedish colonists who came to Delaware in 1638 built the first log cabins in America. The log cabin became the typical frontier home after 1780 (see **Log**

Granger Collection



An early homestead in the colonies in many cases consisted of little more than a simple one-room cabin and a small plot of farmland. Wood, which was plentiful in the colonies, was the chief building material for houses.



Granger Collection

Household chores were shared by members of a colonial family. The early settlers made most of their own clothing, furniture, and cooking utensils. This picture from the 1800's shows colonists in a New England home involved in such activities as cooking, spinning, and churning butter.

cabin). Most of the houses built by the Dutch settlers had $1\frac{1}{2}$ stories. Their doors were divided into upper and lower parts that opened separately. These doors became known as *Dutch doors.*

During the 1700's, many wealthy colonial merchants and planters built homes in a style called Georgian architecture. Most Georgian houses were square or rectangular, with a central stairway and many tall windows. Above the doors and windows were decorative frames of stonework. The homes had fine wood trim and were planned to look balanced and orderly. The wealthiest families imported wallpaper or had fine paneling made for some rooms. See **Georgian architecture.**

A typical plantation home of the gentry stood on a hill and overlooked a bay or river. Gardens and orchards framed the main views from the house. A typical mansion had eight rooms and stood two stories tall. The kitchen, laundry, and other one-room buildings known as *dependencies* stood nearby. Some slaves were housed in the dependencies. Others lived in small one- or two-room houses in a special area called the *slave quarter.* These dwellings typically had dirt floors and no windows.

Furnishings. Most colonial homes had simple and sturdy homemade furnishings. Many had little more than a few tools and cooking utensils, a storage chest, a table made of planks, and a few benches or stools. Some tables converted to chairs, and other pieces folded for storage.

Many colonists slept on mattresses stuffed with straw or cornhusks. Mattresses were laid on the floor or on a wooden frame strung with rope several feet off the floor. The space between the floor and mattress generally was used to store a child's bed during the day. This movable bed, called a *trundle bed,* was pulled out at night. Many colonial women made quilts to cover beds. Quilts consisted of scraps of cloth stitched together to form several layers.

One or more fireplaces provided a colonial home with light and heat. The fires also served for cooking. Candles and lamps that burned animal fat provided extra light.

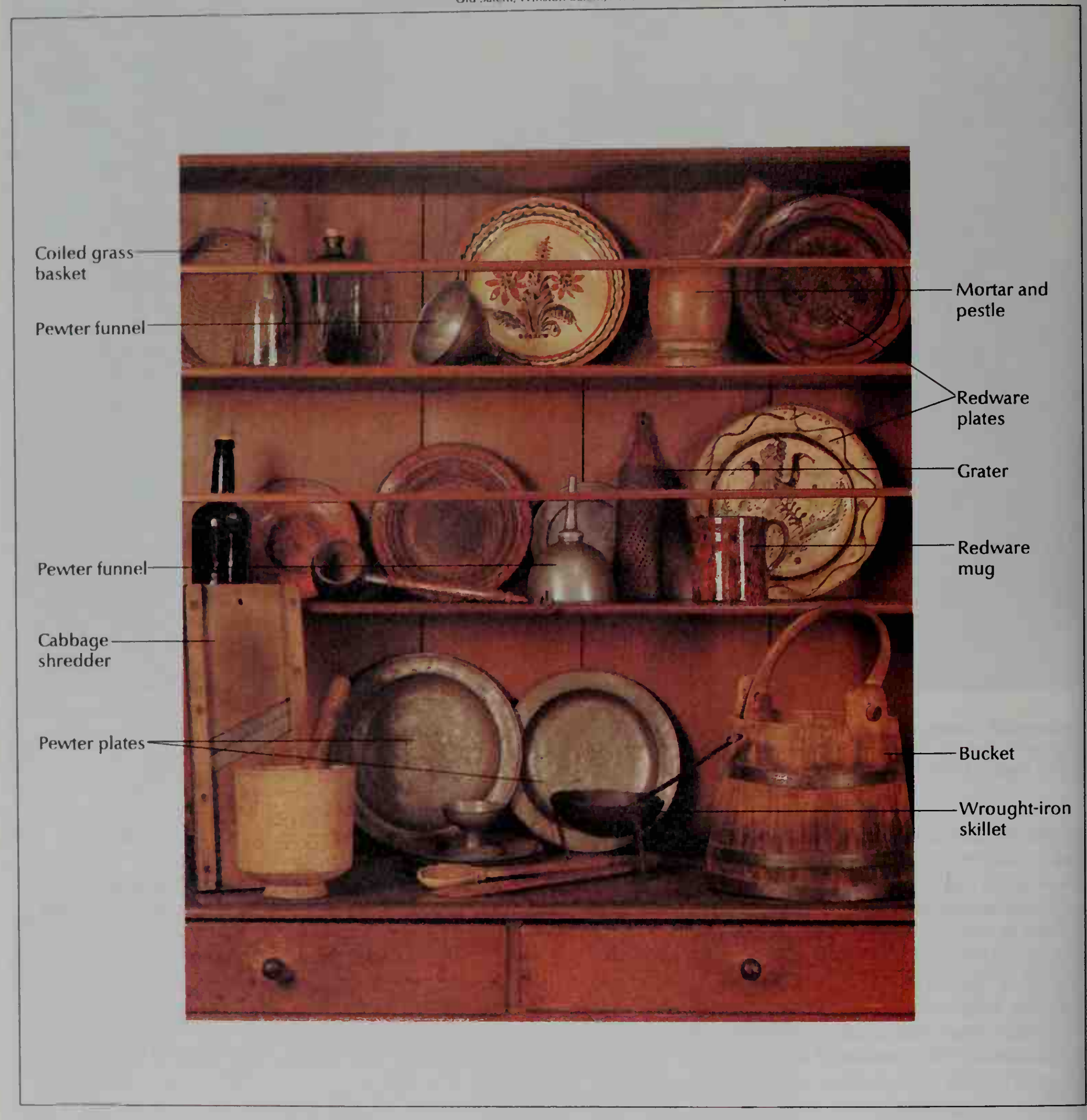
Colonists had few tools and utensils. Some families owned only simple woodworking tools, a few iron pots for cooking and cleaning, and a spinning wheel. Most dishes were made of wood or *pewter.* Pewter is made by combining tin and other metals. In many cases, each person at a meal did not have a separate plate. Instead, two people shared food from a deep wooden plate called a *trencher.* Wooden or pewter spoons were the main eating utensils.

Many colonial tables had special features that saved space. These features included *gate legs* and tops fitted with *drop leaves.* When a larger tabletop was needed,

Some colonial utensils

Most colonists had few utensils for preparing food and for eating and drinking. Most plates were made of wood or *pewter,* which is produced by combining tin and other metals. *Redware* plates were made from reddish clay containing the chemical compound iron oxide.

Old Salem, Winston-Salem, North Carolina (WORLD BOOK photo by Joe Lechleider, Impact Photographic Group)



the gate legs swung out like a gate to support the hinged leaves. At other times, the gate legs were folded and the drop leaves lowered. The most popular chests of drawers were *lowboys* and *highboys.* Lowboys were short chests that served as side tables. Highboys were tall chests with short legs and many drawers. Many highboys were built by placing one chest on top of another.

Wealthier families ordered furnishings from England or from a local skilled worker. Many of these pieces were finely carved and covered in elegant fabrics. Local workers used native cherry, pine, and walnut, or imported mahogany. Items that were made by colonists often followed English furniture designs, but colonists also created new styles. For example, the American inventor, author, and statesman Benjamin Franklin put curved wooden slats at the ends of chair legs to create the rocking chair.

Wealthy colonists imported delicate dishes and elegant wallhangings. Dutch pottery called *delftware* and English china known as *creamware* were popular among the gentry. Silk, damask, or linen curtains and wall coverings hung in well-furnished homes. Some of these homes had a clock. The best-known colonial clock was the *grandfather clock.* It had a tall, elegant case that stood on the floor. The case covered the pulleys, weights, and swinging pendulum that ran the clock.

Families prized mattresses stuffed with feathers, set



Colonial Williamsburg Foundation

Wealthy colonists lived in elegant mansions and wore clothing made of fine fabrics. They entertained in the style of the gentry of England. They often held parties that featured music and dancing. This photograph was taken at a historic village that re-creates life in the colonies.

on frames with high posts, a canopy, and curtains. Women embroidered curtains for these *four-poster beds.* The curtains kept out drafts and provided some privacy.

Clothing. The clothes people wore told much about what they did and their place in the community. Most colonists wore clothing made of linen, wool, or leather. These clothes followed simple styles from England but were made at home. Families of merchants, wealthy farmers, and prosperous craftworkers purchased cloth from Europe, or they imported finished apparel. These garments followed the latest fashion and were made from elegant fabrics.

In most colonial homes, women had the responsibility for making clothes, and they spent many hours at this task. They spun linen from flax and wool yarn from the fleece of sheep. They wove these materials into cloth to be made into clothing. Nuts, berries, roots, and bark provided dye. Sometimes women wove together linen and wool to make a cloth known as *linsey-woolsey.*

Men generally wore long linen shirts and wool breeches gathered at the knee, long knit stockings, and simple leather shoes, boots, or moccasins. Some who worked in the fields went barefoot. For warmth or for formal events, men wore a long vest and jacket over the shirt and a long piece of linen, called a *stock,* tied at the neck. In winter, men added leather leggings, wool mittens, and an overcoat.

Some fashionable men wore wigs. Beginning in the late 1600's, a number of colonial men began wearing the long, flowing wigs fashionable in Europe. In the 1700's, smaller wigs came into use. The most common style was a close-fitting wig, which was drawn back into a braid or small tail. Especially in the 1700's, wigs were powdered to make them white.

Fieldworkers wore straw hats for shade. Laborers and tradesmen wore caps. The most fashionable style had a turned-up brim and was known as a *cocked hat.*

Most women wore a dress of linen or wool, a petticoat, and a long linen undergarment known as a *shift.* For cold weather, they added a cape or hooded cloak.

Adult women wore head coverings both indoors and outdoors. Linen caps were the most common covering. In the summer, however, some women wore a straw hat, and in the winter, a felt one. Women had long hair, which they wore pinned up in a bun or braid. In the 1600's, fashionable women let one or two long curls reach their shoulders. In the 1700's, some women wore elaborate styles for special occasions. They piled their hair high on frameworks they wore on their heads.

Colonial babies and toddlers of both sexes wore a dress that reached to the ground. Older children wore clothes similar to those of adults.

Wealthier colonists had clothing made of fine linen, cotton, silk, satin, and velvet. Men wore linen shirts with lace cuffs and ruffles. Their coats, shoes, and breeches had silver buckles or decorative buttons and trim. Many coats were brightly colored. Wealthier men wore silk

Text continued on page 802

A visitor's guide to colonial America

Every year, millions of visitors tour the region that once was colonial America. Throughout the region, historic sites offer interesting glimpses of colonial life. Almost every town or city has churches or houses that date from the 1700's and a few from the 1600's. In some places, a visitor may walk through the streets of an entire colonial community that has been rebuilt. Many public buildings and museums display colonial items in cities that were important during colonial times—Boston; Charleston, South Carolina; New York City; Newport, Rhode Island; and Philadelphia. Newport has more than 300 colonial buildings.



Gayna Hoffman, Stock Boston

Ephrata Cloisters in Ephrata, Pennsylvania



Jamestown Settlement

Jamestown Settlement in Virginia

Places to visit

Following are brief descriptions of some especially interesting places to visit. See also the *Places to visit* section of the *World Book* article on each state that dates back to colonial times.

Charles Towne Landing, near Charleston, South Carolina, marks the area where South Carolina's first permanent English settlement was established. It includes a replica of a colonial trading ship.

Cherokee Indian Reservation, at Cherokee, North Carolina, includes the Oconaluftee Indian Village, a replica of a Cherokee settlement of the 1700's.

Crailo, in Rensselaer, New York, is a museum that focuses on Hudson Valley Dutch culture. It is a national and state historic landmark.

Ephrata Cloisters, in Ephrata, Pennsylvania, is a restored religious community built by German Seventh-Day Baptists in 1732.

Fort King George, near Darien, Georgia, is a reconstruction of a fort built about 1721.

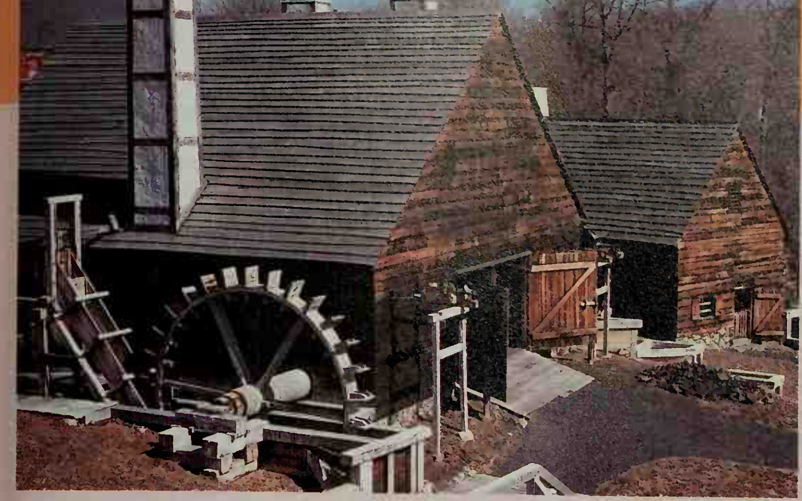
Harvard University, in Cambridge, Massachusetts, is the oldest institution of higher learning in the United States. It was founded in 1636.

Henry Francis Du Pont Winterthur Museum, near Wilmington, Delaware, has a magnificent collection of early American furniture and decorative arts.

Henry Whitfield State Museum, in Guilford, Connecticut, is the oldest stone building in New England. It was built in 1639.

Historic St. Mary's City, near Leonardtown, Maryland, is an outdoor museum on the site of Maryland's first colonial settlement, begun in 1634 as St. Marys City.

Jamestown Colonial National Historical Park, on the James River in Virginia, is the site of the first permanent English settlement in America. Nearby, **Jamestown Settlement** is a living history museum that represents life in colonial Jamestown. The settlement has reproductions of old James Fort and of the three ships that brought the first settlers to Jamestown.



Saugus Iron Works in Saugus, Massachusetts

Eric Neurath, Stock Boston



Ted Curtin, Plimoth Plantation, Inc.

Plimoth Plantation in Plymouth, Massachusetts

Places to visit

Old Barracks Museum, in Trenton, New Jersey, was a barracks used by British soldiers during the French and Indian wars (1689-1763). It is the only barracks from the period still standing in the United States.

Old Fort Niagara, near Youngstown, New York, was the scene of fighting during the French and Indian wars and the Revolutionary War in America. It was built in 1726.

Old Gaol Museum, in York, Maine, was built in 1653 as a jail (gaol) and is the oldest public building in Maine.

Old Narragansett Church, in North Kingstown, Rhode Island, is the oldest Episcopal church in the northern United States. It was built in 1707.

Old Salem is a restored colonial village in Winston-Salem, North Carolina. Moravians founded the village in 1766.

Plimoth Plantation, in Plymouth, Massachusetts, is a re-creation of a Pilgrim village.

Saugus Iron Works National Historic Site, in Saugus, Massachusetts, is a reconstruction of the first successful ironworks in the colonies, built in the 1640's.

Shelburne Museum, in Shelburne, Vermont, is a reconstruction of an early American village. The buildings house one of the world's most complete collections of articles used by the settlers.

Strawbery Banke Museum, in Portsmouth, New Hampshire, is a restoration of a colonial seaport, settled in 1630.

Touro Synagogue, in Newport, Rhode Island, is the oldest synagogue still standing in North America. It was completed in 1763.

Whitehorse Tavern, in Newport, Rhode Island, was built in 1673. It is the oldest continuously operating tavern in America.

Williamsburg is a Virginia city whose colonial buildings have been restored or rebuilt. Colonial Williamsburg provides a look at the buildings, gardens, furnishings, crafts, and social life of the 1700's.

Witch House, in Salem, Massachusetts, was the home of Jonathan Corwin, a judge at the Salem witchcraft trials of the early 1690's.



From *Alle de Wercken* (1657-1659) by Jacob Cats; Folger Shakespeare Library, Washington, D.C.

Shearing sheep and cutting bristles from hogs supplied materials for many colonial household items. The sheep's wool was spun into yarn, and the hog bristles were used to make brushes.

hose and carried linen handkerchiefs.

Women from wealthy families also dressed in fine fabrics. They wore low-necked dresses that fit tightly at the waist and above and were trimmed with lace at the neck and sleeves. Tight corsets slimmed their waists. Whalebone or wire hoops supported the skirts, which were drawn back to show elegant petticoats. Wealthy women wore silk or leather shoes with silk stockings.

The clothes of slaves depended on the work they did and the wealth of the family. Those who worked in the fields often wore simple shifts of homemade cloth, or a *breechcloth*—that is, a piece of cloth tied about the waist. Some slaves wore old clothes given to them by their masters and mistresses.

Food and drink. After the early starving time, colonists had plenty to eat, even if the meals seemed much the same from day to day. They ate a breakfast of mush and meat or cheese followed at about noon by their main meal of the day. Most midday meals consisted of stews cooked in a pot hung in the fireplace. The evening meal was often bread, cheese, and anything left in the pot from midday. Meats and vegetables for the stews changed with the season because the colonists had few ways of preserving foods. For example, they salted some meats and dried certain vegetables. Root crops, such as squash, turnips, or carrots, and fruits, such as apples and pears, could be kept in a cool, dry cellar.

Corn was one of the most important foods eaten by the colonists. Women made mush and hoecakes and other kinds of corn bread from ground corn meal. They also prepared a dish called *hominy* by softening whole, dried corn in lye or water to remove the hull. They made *succotash* by combining corn and beans. Corn roasted in its husk over the fire was a special treat. Servants, slaves, and poor families often had little besides corn and garden vegetables for food.

The most common meats were ham, bacon, and other forms of pork. Hogs ran loose around the farm and countryside, eating what they could find. Colonists also kept sheep and chickens. Hunting added turkey, deer, squirrel, and other game to the diet. Colonists ate both fresh and dried fish.

Cattle and goats provided meat as well as milk for drinking. Women made butter and cheese from the milk.

Colonists grew wheat, rye, and oats for grain, which was used chiefly to make bread. Colonial women baked the bread in fireplace ovens or in iron containers called *bake kettles.* Fireplace ovens were openings built in the stone or brick and warmed by the chimney. A bake kettle had a tight lid and was placed on hot coals with embers piled around it.

Colonial families also gathered fruits, nuts, and berries in season. Sage, marjoram, and other seasonings came from the garden.

The most common drinks were beer, ale, and cider, all brewed at home. The colonists drank imported and local wines and rum. They consumed very little water, which they feared would make them sick.

After 1700, colonial cooking began to change to include more roasted meats, separate vegetable dishes, and more baked items. Colonists began to import chocolate, coffee, tea, and spices. The new cooking required more tools, including pans and spits for turning meats on open fires.

Recreation. Social gatherings were an important part of colonial life. Colonists often combined work and play in parties called *frolics.* When colonists worked together to raise the frames for buildings, for example, they also held games and contests, such as plowing contests and footraces. These gatherings also featured food, drink, and music. Except for Puritans, Quakers, and certain other religious groups, colonists of all classes enjoyed dancing. Jigs, reels, and other lively dances were especially popular.

Colonists gathered on Sundays to visit one another before and after church services. Monthly court sessions, election days, and militia drills also gave colonists chances to get together to exchange news and eat



Detail from the frontispiece to Dilworth's *New Guide to the English Tongue;* Folger Shakespeare Library, Washington, D.C.

Children's games in colonial times included many that are still popular. The youngsters shot marbles, flew kites, and played hopscotch, leapfrog, prisoners' base, and blindman's buff.

and drink. Weddings became occasions for parties and gift giving. Colonists sometimes held local fairs, which often featured horse races and fights that pitted animals against each other. People living in colonial towns could hear lectures on science, join literary clubs, or attend concerts and plays.

Holidays provided another opportunity for people to get together. The celebration of holidays varied among the colonies. The most widely celebrated holidays were four days that marked the seasons. March 25 was called Lady's Day; June 24, midsummer; September 29, Michaelmas; and December 25, Christmas. Most New England colonies followed Old World traditions of holding harvest festivals in the fall. A number of colonies celebrated traditional church holidays, such as Easter, Whitsunday (Pentecost), and St. Valentine's Day. Puritans in New England recognized only Sunday as a special day and passed laws against celebrating Christmas.

Taverns, sometimes called *ordinaries,* were favorite gathering places for men. There, they smoked, drank, read newspapers, and played cards. Some women worked in taverns, and a number of women became tavern owners. Some taverns offered dancing or billiards.

Children played with homemade toys, including balls, marbles, kites, and dolls. They also played hopscotch, leapfrog, London Bridge, and other games. Children of the gentry had imported toys, such as tea sets and finely crafted dolls and toy soldiers.

Education and religion

Education. Colonial children learned many practical lessons at home. Fathers taught sons how to farm, hunt, and build and repair things. Mothers showed daughters how to care for gardens, sew, spin, cook, and look after livestock. Some children worked with their parents in skilled crafts, such as shoemaking or weaving.

Some children and young adults joined other households as apprentices to skilled workers or professional people to learn trades or such professions as medicine and law. The families that took on an apprentice signed a contract promising to provide the apprentice with bed and board and the skills of a trade. In exchange, they were to receive faithful service from the apprentice for a certain period. Orphans were often *bound out*—that is, placed as servants—to families who promised to teach them skills.

Some families who wanted their children to read and write taught them at home. However, books were expensive, and many families owned only a Bible. In the 1700's, many families bought almanacs and newspapers. The gentry, on the other hand, could afford libraries for their homes, and many members of this class hired tutors for their children. Some apprenticeship agreements included a promise to teach reading and writing.

Schools. Some colonial families joined together to hire a teacher to run a small school. During the early colonial period, schools known as *free schools* were established. These schools charged tuition and were free from church oversight. Some teachers opened schools in their homes. For example, *dame schools* were run by women who taught basic reading and writing to young children.

In 1642, Massachusetts passed a law requiring parents to teach their children to read. In 1647, the colony passed the first law in America requiring communities to establish public schools. The law stated that every town with at least 50 families had to start an elementary school and every town of at least 100 families had to have a Latin grammar school. Today, elementary schools and grammar schools are much alike, but the grammar schools in colonial times were more like today's high schools. Colonial elementary schools taught religion, spelling, reading, writing, and arithmetic. Grammar schools prepared more advanced students for college. They offered lessons in religion, Latin and Greek, English composition, geography, and mathematics.

Some grammar schools were run by colleges, but others were private. Many elementary schools provided only a short summer session for girls or taught them at hours when boys were not in school. Grammar schools did not admit girls.

By the mid-1700's, schools called *academies* began to be established in the colonies. They offered more practical courses than did grammar schools. Subjects ranged from the liberal arts, such as history and philosophy, to

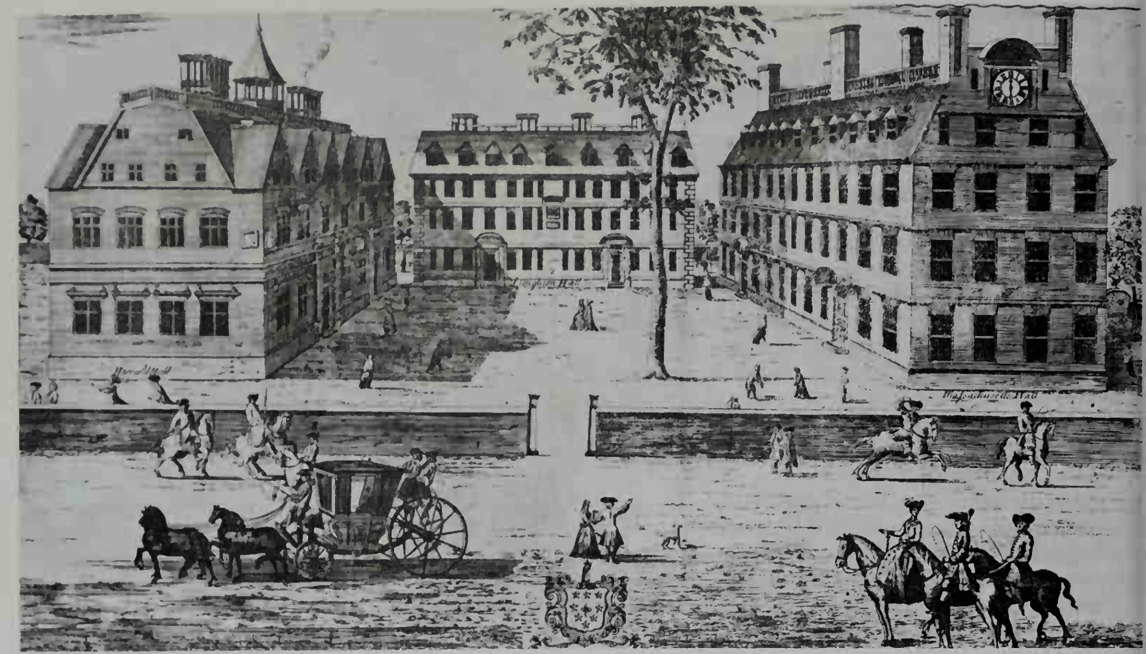
Important dates in colonial education

1635	Boston Latin School, the first secondary school in the colonies, began classes.
1636	Harvard College (now Harvard University) became the first institution of higher learning in what would be the United States.
1647	Massachusetts established the first colonial public school system.
c. 1690	The *New England Primer* was published. It was a commonly used textbook in colonial schools.
1723	The first permanent school for Indians in the colonies was established at the College of William and Mary in Williamsburg, Virginia.
1751	The Philadelphia Academy opened with Benjamin Franklin as its president. The school provided education on a wide range of practical and academic subjects.
1773	The first museum officially established in the colonies was founded in Charles Town (now Charleston), South Carolina.



Granger Collection

Most colonial schoolchildren came from rich families and attended one-room schoolhouses, *above.* Poor children remained at home and learned skills that helped support the household.



"A Prospect of the Colledges in Cambridge in New England" engraved by William Burgis; New York Public Library, I. N. Phelps Stokes Collection

The first college in the colonies was founded in Massachusetts in 1636. It later became Harvard University. Harvard, like other universities during the colonial period, admitted only men.

practical subjects, such as navigation and sewing. Some academies admitted girls, and some were for girls only. By 1775, a majority of whites could read and write.

Only a few slaves and free black children attended school. Some religious and charitable groups set up schools for blacks. Very young children attended schools for blacks, but usually only for short periods.

In 1636, Massachusetts established what is now Harvard University, the first college in the colonies. Women were not admitted to any college in America during the colonial period. By 1775, there were colleges in five colonies. Some colonists went to England to study.

Learning materials. Colonial schools had few books or other learning materials. Children often learned lessons from *hornbooks.* A hornbook was a paddle-shaped piece of wood with a sheet of paper pasted to it. A thin layer of transparent horn protected the paper, which was scarce and expensive in colonial times. Typically the alphabet, the Lord's Prayer, and the Roman numerals were on the paper.

The most widely used textbook in the colonies was the *New England Primer,* which was first published about 1690. It included information from the hornbook as well as the Ten Commandments, a catechism, and bits of moral instruction. It also featured rhymes for learning the alphabet. For example, the rhyme for the letter *M* was "The Moon gives light/In time of night."

Religion had a strong influence on the social and political life of the colonists. Many of the colonists had come to America chiefly so they could worship according to their beliefs. Some European governments had persecuted certain religious groups for breaking away from traditional or state-supported churches and trying to establish new forms of worship.

Most colonial religious groups dated from the 1500's. They developed during the Reformation, a religious movement in Europe that resulted in the birth of Protestantism. Many Anglicans moved to the colonies, as did large numbers of Puritans, Quakers, Baptists, Huguenots, and other persecuted groups.

Established churches. Members of the various religious groups that came to America usually settled near others with similar beliefs. These groups were more interested in finding a place to live according to their religious rules than in granting religious freedom to others. As a result, some colonies supported one church, often called an *established church,* within their boundaries and denied freedom of worship to other religious groups. Established churches received tax support from colonial legislatures.

The Puritans established the Congregational Church in the New England colonies of Connecticut, Massachusetts, and New Hampshire. Pennsylvania and Delaware granted all churches freedom of worship, but laws re-

Important dates in colonial religion

1629 The first non-Separatist Congregational Church in America was established in Salem, Massachusetts.

1647 A law passed in Massachusetts made it illegal for Roman Catholic priests to enter territory under Puritan control.

1649 Maryland passed a religious toleration act. This law granted religious liberty to all Christians.

1675 Massachusetts passed a law requiring church doors to be locked during services to keep people from leaving during long sermons.

1692 Witchcraft trials were held in Salem, Massachusetts.

1730's The revival movement known as the Great Awakening began in the colonies.

flected Quaker beliefs. Rhode Island also welcomed all groups. In New York and New Jersey, which the English captured from the Dutch in 1664, no single religious group was strong enough to force its church to become the established church. Maryland, founded partly as a refuge for Catholics, had many Protestant settlers. In response to religious unrest, Maryland's colonial leaders in 1649 passed the first religious toleration act in the British Empire. This law granted religious liberty to all Christians, but it was soon repealed. In 1692, the Anglican Church became the established church in Maryland. The Anglican Church was also the official church in Virginia and the Southern Colonies.

A colonial Sunday. The colonies set aside Sunday as a day of worship. Regulations known as *blue laws* kept stores and businesses closed on Sundays (see **Blue laws**). Even slaves had part of Sunday as free time. Sunday services included long sermons by the clergy and psalm singing by the congregation. Church seating was assigned by sex, race, and wealth. Before and after services, the churchyard served as a social center for neighborly visits, exchange of news, and courtship.

Witchcraft. Colonists brought traditional beliefs in folk magic and witches with them from Europe. They blamed unexplained misfortunes on witchcraft. Several colonies tried individuals as witches, and some people were executed. The last—and largest—witchcraft trials were held in 1692 in Salem, Massachusetts. Seventeen women and three men were executed as a result of the Salem trials. About 150 others were imprisoned on witchcraft charges. See **Salem witchcraft trials; Witchcraft.**

Religious diversity and tolerance increased in the colonies during the 1700's. Many Germans, Scots, and Scotch-Irish migrated to the colonies and brought their religious traditions with them. These new immigrants included members of the German-Reformed, Lutheran, Moravian, Presbyterian, and Roman Catholic churches. Jews, forced out of Europe and South America for their religious beliefs, settled in small numbers. Africans, imported as slaves, brought Muslim and traditional African religious beliefs with them. The clergy and some owners made occasional efforts to convert slaves to Christianity during the colonial period, but for the most part, slaves were left to follow their own beliefs.

Beginning in the 1730's, a series of religious revivals called the Great Awakening divided existing churches. During the Great Awakening, traveling preachers drew large audiences to hear their sermons. Some preachers were women or slaves. Revival meetings were often held in the open air. Preaching was lively, and people responded emotionally. Listeners sometimes wept, fainted, or shook all over.

The stirring sermons of George Whitefield and other Awakening preachers called on listeners to repent of their sins and seek salvation. The evangelists discouraged cardplaying, dancing, and other amusements that they considered "worldly." They criticized established churches and pushed to separate church and state. See **Great Awakening.**

Transportation and communication

Transportation in the colonies was slow and difficult. In general, colonists traveled by boat or horse, or on foot. Most colonies had at least one major river that could take boats inland for many miles before reaching a rapids. Major rivers in the Southern and Middle colonies were deep enough for ocean vessels. The colonists built many boats for trading along the coast. The vessels used by colonists for transporting passengers and freight by sea included brigantines, schooners, shallops, sloops, and other sailing craft. On rivers and bays, these vessels were joined by canoes, flatboats, and rowboats.



Bettmann Archive

Preaching at revival meetings during a period known as the Great Awakening, George Whitefield, the famous evangelist, aroused excitement among thousands of colonists .

The first colonial roads were merely paths through the woodlands and countryside. The colonists widened the paths for travel on horseback and later for carts and wagons pulled by horses or oxen. Most colonial bridges were made of wood, and many were in poor condition. Consequently, most travelers on horseback or in wheeled vehicles forded rivers at shallow spots or paid to cross on a ferry.

The colonists put much effort into building roads, and local work crews worked to keep them in repair. By 1760, the colonies had several major roads. For example,

Important dates in colonial transportation and communication

1630 The first ferry route in the colonies was established in Massachusetts.

1672 The Boston Post Road was completed, linking Boston and New York City. Mounted mail carriers began using the road in 1673.

1690 *Publick Occurrences,* published in Boston, became the first newspaper printed in the colonies. However, colonial authorities forced it to cease publication after only one issue.

1691 The English government allowed a private postal system to be set up in the colonies.

1704 The *Boston News-Letter* became the first regularly published newspaper in the colonies.

1732 The first stagecoach line was established in the colonies. It ran between Burlington and Amboy, New Jersey. Passengers could make connections from Amboy to New York City and from Burlington to Philadelphia by boat.

1753 Benjamin Franklin became a deputy postmaster general for the colonies. He improved the frequency and speed of mail delivery.



Colonial Williamsburg Foundation

Colonial transportation was usually slow and difficult. But by the mid-1700's, government officials and wealthy colonists in the towns rode in comfortable passenger vehicles, such as the coach shown at the left. Stagecoaches also began to operate in the colonies by the mid-1700's.

one road linked New York City and Portsmouth, New Hampshire, and passed through Boston and other cities along the way. The Great Wagon Road ran through mountain valleys and connected Philadelphia and the back country of Georgia. By the mid-1700's, stagecoach lines ran between Boston and Providence, Rhode Island; and linked New York City with Philadelphia and Annapolis, Maryland.

Communication. During the 1600's, the colonists exchanged news chiefly by word of mouth. Gossip spread swiftly at church, court days, or public gatherings. Official notices were announced at church or posted on the doors of public buildings. Towns and cities had a *crier* who read announcements on the street. Much of the news from outside a community was learned informally as visitors came to an area. Travelers passed letters, carried letters for friends, or left them at inns for others to claim or pass on.

Individuals called *post riders* carried mail along routes called *post roads.* They picked up mail and left it at inns, taverns, or other established stopping places. The English government allowed a private postal system to be set up in 1691 and took over its operations in 1707. Service to all areas, especially the Chesapeake and Southern colonies, came slowly. In 1753, Benjamin Franklin became a deputy postmaster general for the colonies. He improved the frequency and speed of postal service.

Newspapers came into general use after the mid-1700's. The *Boston News-Letter,* founded in 1704, was the first successful colonial newspaper. By 1775, all the colonies except Delaware and New Jersey had at least one newspaper. Newspapers appeared weekly. They were passed from one person to another and were available in taverns. They had stories from other newspapers; local advertisements; short items of local news; and letters, poems, and essays by local writers.

Arts

In the early years, colonists had little time or money to support the arts. But by the 1700's, they developed a lively interest in music, art, theater, and literature.

Literature. Some of the early colonists wrote to tell Europeans about life in the New World. For example, the colonial leader John Smith wrote about Jamestown. Other early colonists translated classics or wrote sermons. At first, colonial works had to be sent to England for publication because the colonies did not have a printing press. In 1639, however, Stephen Daye and his son Matthew set up the first printing press in what is now the United States, in Cambridge, Massachusetts.

Most early colonial literature was religious. The *Bay Psalm Book,* published by the Dayes in 1640, was the first book printed in the American Colonies. It was a collection of psalms prepared by several ministers.

By the late 1600's, colonial printers were still publishing sermons and other religious writings, but they were printing almanacs, essays, histories, satires, and travel accounts as well. Mary Rowlandson's description of her capture by Indians, published in 1682, became the first of many captivity stories. The religious leaders Jonathan

Important dates in colonial arts

1608 *A True Relation of. . .Virginia* by Captain John Smith was published in England. It was the first book from the colonies to be published.

1640 The *Bay Psalm Book* became the first book printed in the colonies.

1716 The first theater in the colonies was built in Williamsburg, Virginia.

1721 The first recorded art commission for a public building in the colonies was given to the Swedish painter Gustavus Hesselius. He was to paint an altarpiece showing the Last Supper for a church in Maryland.

1762 The gentry of Charles Town (now Charleston), South Carolina, founded the St. Cecilia Society, the first music society in the colonies. The society organized and presented private concerts.

1767 The *Prince of Parthia* by Thomas Godfrey was presented in Philadelphia. It was the first play by an American to be performed by professional actors.

1770 William Billings published *The New England Psalm Singer,* the first collection of original musical compositions written by an American.

Edwards, John Woolman, and Cotton Mather produced a number of important works during the 1700's. Benjamin Franklin published the highly successful *Poor Richard's Almanac* for each year from 1733 to 1758. This work became known for its wise and witty proverbs. After 1750, colonists wrote and published many essays and pamphlets about political controversies.

A number of volumes of poetry were published by colonial writers. Readers also passed around unpublished poems and plays. Anne Bradstreet became the first colonial woman to have her poetry published when her collection *The Tenth Muse Lately Sprung Up in America* appeared in England in 1650. Michael Wigglesworth's long religious poem, *Day of Doom* (1662), became the most popular poem of colonial times. Phillis Wheatley, an African-born slave, became known for her collection of *Poems on Various Subjects, Religious and Moral* (1773), published in England.

For a detailed account of colonial writers and their works, see **American literature** (Colonial literature [1608-1764]).

Painting. Early American artists had little formal training. They traveled throughout the colonies and earned a living by painting portraits. After 1700, some European-trained painters who had arrived in the colonies painted portraits of the wealthy. Among the most skilled were Charles Bridges, Gustavus Hesselius, and John Smibert. The American-born painters Ralph Earl and Robert Feke also became known for their portraits.

Beginning in the mid-1700's, some of the finest American artists spent time studying or painting in Europe.



Portrait of Isaac Royall and His Family (1741) by Robert Feke; Harvard Law School, Cambridge, Massachusetts.

Painting of a distinguished New England family is a fine example of the work of Robert Feke, a colonial artist whose portraits have become famous.



Needlework picture by Dorothy Cotton, Henry Francis du Pont Winterthur Museum, Winterthur, Delaware

Detailed needlework produced by colonial women was used to decorate homes. Today, such needlework is highly prized by collectors of antiques.



Granger Collection

Phillis Wheatley, an African-born slave, was the first black American poet. Her collection of *Poems on Various Subjects, Religious and Moral* was published in England in 1773.

They included John Singleton Copley, Charles Willson Peale, Gilbert Stuart, and Benjamin West.

Decorative arts. During the early colonial period, most of the settlers made their own furniture and household articles. Wealthy colonists generally imported their furnishings from England. During the 1700's, skilled colonial craftworkers turned everyday items into works of art. They made many fine products of wood, silver, pewter, or glass.

Furniture in the early colonial times was heavy. But in the early 1700's, styles became lighter and more graceful. During the 1700's, some wealthier colonists imported finely crafted pieces from the workshops of the famous English furniture makers Thomas Chippendale, Thomas Sheraton, and George Hepplewhite.

Gold, silver, and pewter. Colonial goldsmiths and silversmiths created elegant bowls, tableware, and tankards. Pewter provided less expensive ware. Smiths

melted the metal and then poured it into molds. Engraved designs on gold, silver, and pewter items resembled the patterns that appeared in furniture.

Other decorative arts included glassware and needlework. Many of the bottles and much of the fine table glass produced by colonial glassmakers were beautifully colored and molded in patterns. The detailed needlework produced by colonial women was used to decorate homes. For more information on colonial decorative arts, see **Antique.**

Music was a part of many church services. Congregations sang musical versions of the psalms. Only a few parishes owned organs, and so most singing was unaccompanied. Music also was important in the daily lives of the colonists. They played music at weddings and other celebrations and at home. They often composed new words to accompany old melodies they brought with them from Europe. Professional musicians performed at concert halls and theaters. The first colonial orchestra formed in Charles Town in 1750.

Colonists played a variety of musical instruments. Settlers bought or brought with them violins, guitars, and other European instruments. Some wealthy Southern planters purchased expensive harpsichords for their homes. Black slaves made banjos and other stringed instruments similar to those they used in Africa. Many slaves also became skilled fiddlers and were in demand to play at dances.

Science, health, and medicine

Science. Colonial scientists kept careful records of the weather and the laboratory experiments they per-



Made by John Coney; Museum of Fine Arts, Boston, Gift of Mrs. J. R. Churchill

Silversmithing was a leading craft in the colonies. Most towns had a silversmith who made beautiful silver pieces, such as the sugar bowl, *above.*



Corning Museum of Glass, Corning, New York

Henry Francis du Pont Winterthur Museum, Winterthur, Delaware

Glassmaking began in the American Colonies during the mid-1700's. Some colonists who learned glassmaking techniques established glass factories and manufactured various household items. The first successful glass factory opened in Salem County, New Jersey, in 1739. Most of the first American glassmakers were European immigrants, and they closely followed English, German, and other European models. Early American glassware included pieces that were beautifully colored and molded in patterns, like the blue sugar bowl pictured above left. A glass taper, or candlestick, *above right,* provided indoor lighting as well as elegant decoration.



Museum of Fine Arts, Boston, William F. Nickerson Fund

Furniture made by colonial cabinetmakers of the mid-1700's is noted for its graceful design. The card table above has a needlepoint top.



Pewter was used for many colonial household items because it was less expensive than silver. An engraved tankard, *right,* could be found in many homes.

Pewter tankard made by Simon Edgell; Henry Francis du Pont Winterthur Museum, Winterthur, Delaware

Important dates in colonial science and medicine

1693 A yellow fever epidemic struck Boston.
1721 The first smallpox inoculations in America were given in Boston by the physician Zabdiel Boylston. He had been urged to do so by the Puritan minister Cotton Mather.
1728 Botanist John Bartram opened the first botanical garden in the colonies, near Philadelphia.
1748 Jared Eliot, a New England minister, physician, and farmer, began publishing *An Essay on Field Husbandry in New England,* in which he attempted to apply scientific principles to agriculture.
1752 Benjamin Franklin conducted his most famous electrical experiment. He flew a homemade kite during a thunderstorm and proved that lightning is electricity.
1767 David Rittenhouse, an astronomer and instrument maker from Philadelphia, built an instrument called an *orrery,* which showed the positions of the planets in the solar system.

formed. They were well informed about new discoveries in astronomy, chemistry, meteorology, and physics. They exchanged ideas with European scientists and sent reports and specimens to Europe.

A number of colonial scientists studied the plant and animal life of the New World. In 1728, the botanist John Bartram planted the colonies' first botanical garden, near Philadelphia. Other colonial naturalists included Bartram's son William, John Clayton, Cadwallader Colden, Alexander Garden, and John Mitchell.

Benjamin Franklin became known throughout the world for his experiments and inventions. He gained particular fame for his work on the study of electricity. In 1743, Franklin and other Philadelphia scholars founded the American Philosophical Society. This organization became the chief colonial scientific body.

A number of other scientists also made valuable contributions to scientific knowledge in the colonies. For example, the Puritan minister Cotton Mather published one of the first good descriptions of smallpox inoculation.

Health and medicine. Colonists suffered from a wide variety of diseases. Colds and influenza were common. *Scurvy*—that is, a lack of vitamin C—occurred widely among the early colonists. Many settlers in the Southern and Middle colonies suffered from malaria, yellow fever, and typhoid. Many colonists also developed pneumonia, tuberculosis, and diphtheria. Beginning in the mid-1600's, several epidemics of measles and smallpox swept through the colonies and killed large numbers of people. Measles and smallpox proved fatal especially to American Indians, who had no immunity to these diseases.

Colonists relied mainly on home cures and folk remedies to treat diseases. They often borrowed African and Indian cures. Such treatments typically involved the use of barks, herbs, and roots. Quinine, for example, is a bitter substance taken from the bark of the cinchona tree. The colonists used it to treat malaria and a malarial fever called *ague.* Doctors still use it today to treat some forms of malaria.

There were few formally trained doctors during most of the colonial period. Skilled midwives delivered most babies. Most doctors either taught themselves or studied medicine by helping experienced physicians, but some attended medical schools in Europe. Established medical practice of the day maintained that illness resulted from an imbalance of four fluids called *humors* that were believed to be in the body. One of the chief methods physicians used in their attempts to restore the balance of the humors was *bloodletting*—that is, removing blood from a patient.

The economy

Farming was the chief economic activity of the colonists. Colonists raised crops for export to other colonies and to England. The main colonial cash crops included corn, wheat, rice, indigo, and tobacco. Rum also became an important export. In return for their products, the colonists imported manufactured goods from England for their own use and for trade with the Indians.

Through the years, the colonies developed a number of industries. These industries included fishing and whaling, lumbering, ironmaking, and shipbuilding.

Farming. Nearly all the colonists did at least some farming. Colonial farms produced enough food to provide a comfortable, but limited, diet to all. Settlers brought wheat, oats, rye, and barley from Europe. They learned to plant corn and tobacco from Indians, and black slaves probably taught the white colonists to plant rice. Nearly all colonial farmers owned a few cattle, hogs, and chickens, and some raised livestock commercially.

When possible, colonial farmers planted crops on only a portion of their farms. They usually planted the same kind of crop repeatedly, and the land became exhausted after a few harvests. The farmers then cleared a new field and let the old one become pasture or return to scrub. After 1750, some farmers added fertilizers to the soil, rotated crops, and used other methods to keep their land productive.

Farm tools were simple. Most were handmade or bought from local blacksmiths. The hoe was used to cultivate corn, tobacco, and other crops. Colonial women and children often did the hoeing. Colonists used scythes and sickles to cut grass and grain, and spades to turn the earth. The *mattock,* a tool like a pickax but with flat blades, broke up soil and cut roots. During the 1700's, more farmers began using wood plows pulled by teams of horses or oxen to prepare soil for planting.

The kinds of crops planted varied among the colo-

Important dates in the economy of the colonies

1607 The first ship built by English settlers in the colonies, the *Virginia,* was constructed on the Kennebec River in what is now Maine.
1608 Colonists in Jamestown established a glass factory. However, the venture failed within a year because many colonists died in a famine.
1646 The first North American ironworks to maintain production for a long period opened in what is now Saugus, Massachusetts.
1651 The British Parliament began passing the Navigation Acts to closely regulate colonial trade.
1739 Glassmaker Caspar Wistar opened a glass factory in what is now Salem County, New Jersey. The plant operated until 1780.
1750 The British Parliament passed the first Iron Act. This law made it illegal for the colonies to build new mills to produce finished iron products. On the other hand, it encouraged them to export crude forms of iron called *pig iron* and *bar iron* to Britain for finishing.



Granger Collection

Huge barrels that could easily be rolled aboard a ship were used for exporting tobacco and other products. This engraving shows an English ship on the James River in Virginia being loaded with tobacco for export to England.

nies. Farmers in New England grew grains and garden crops. In general, the soil there was too poor and the farms too small to produce crops for trade. However, the Connecticut Valley grew some tobacco for export, and Rhode Island developed a dairy industry.

Farms in the Middle Colonies benefited from fertile soil and a favorable climate. The Middle Colonies shipped large quantities of wheat, corn, rye, dairy products, and meat to colonial and international markets. They produced so much grain that they became known as the "bread colonies."

The plantations of the Chesapeake Colonies grew tobacco for export. Large farms in the region produced wheat and meat. Farmers in South Carolina and Georgia exported rice and, after 1750, indigo. Most farms in North Carolina were small, and farmers there generally grew only enough food for their own use.

Fishing and whaling. Massachusetts became the center of colonial fishing and whaling. The region was close to the Grand Banks, off Newfoundland, and other rich fishing areas. Boston, Gloucester, Marblehead, and Salem became the most important fishing ports. The catches included cod, herring, halibut, and mackerel, which were dried and salted on shore. The best grades of fish usually went to southern Europe. Much of the rest was shipped to the West Indies to be used as food for the slaves who worked on sugar plantations.

New Bedford, Provincetown, and Nantucket Island became centers for whaling. Whales were valuable for whale oil, which was used in lamps, and for whalebone, which was used to stiffen women's clothes. For details of the early whaling industry, see Whale (American whaling).

Lumbering and shipbuilding. Every colony had large supplies of timber, and lumber became one of the chief exports of the colonies. Colonists built houses, fences, and boats from wood. Many wood products also played an important part in other colonial industries. Millions of wooden staves were used to make barrels for shipping rice, tobacco, fish, and other products.

The vast timber resources of the colonies helped them develop a thriving shipbuilding industry. New England was the main colonial shipbuilding center, though the Chesapeake Colonies and South Carolina were important in the industry as well. New England forests provided good ship timber, including cedar, maple, and oak. The tall and thick white pines of the region were used for ship masts. Pine also provided pitch and tar for keeping ships watertight. The live oak trees of the Chesapeake Colonies and South Carolina also provided excellent shipbuilding timber.

England encouraged colonial shipbuilding because



"Colonial Phillip Skene's sawmill and blockhouse, Fort Ann, N.Y." from a sketch by Thomas Anburey; Library of Congress

Great supplies of lumber were produced by all the colonies. The timber was used in building homes and ships, and in making millions of barrels for colonial trade and industry.

its own best timber had been used up. By the end of the colonial period, about a third of Britain's merchant ships were being made in America.

Ironmaking. Iron ore was mined in most of the colonies. The colonists obtained charcoal, the chief fuel used to smelt iron ore, from their large supplies of hardwood trees. Colonists began operating a blast furnace near Jamestown in 1621, but it was destroyed during an Indian raid in 1622. In 1646, the first North American ironworks to maintain production for a long period started in what is now Saugus, Massachusetts. By 1775, the colonies were producing about one-seventh of the world's iron.

Some colonial iron went to England in crude forms known as *pig iron* and *bar iron* for English workers to finish. But the colonists themselves provided the most important market for the ironmaking industry. Blacksmiths in colonial communities hammered out various products, including nails, tools, hinges, and weather vanes. Large ironworks also manufactured these products, as well as kettles, pots, wire, and parts for wagons and carriages.

Other industries in the colonies included brewing, papermaking, ropemaking, and tanning. Some colonial towns became centers for craft manufacturing, such as glassmaking or silversmithing. Many industries developed because communities needed certain products or services. Almost as soon as a colonial village was established, for example, someone set up a grist mill to grind grain into flour or meal. As the community grew, it needed a blacksmith to make and repair tools and a cooper to make barrels. Skilled carpenters and shoemakers also established businesses throughout the colonies.

Trade. England regulated the trade of the colonies according to an economic system known as *mercantilism.* English mercantilism was designed to protect the nation's industries against competition from the industries of other countries. Under mercantilism, England expected the colonies to supply it with raw materials and to buy finished English goods.

Beginning in 1651, Parliament passed a series of laws aimed at strengthening the English government's control over colonial trade. These laws, which were called the Navigation Acts, required the colonies to export certain items only to England or other English colonies. These items included fur, indigo, iron, naval products, and tobacco. The Navigation Acts also required the colonies to receive almost all imports through England, and to ship and receive goods in English or colonial ships. See **Mercantilism; Navigation Acts.**

Colonial trade flowed in several patterns. The colonies on the North American mainland engaged in lively coastal trade among themselves. They also shipped tobacco, indigo, and lumber directly to England. Men and women traded small surpluses of yarn, cloth, cheese, poultry, eggs, ale, and garden products for goods at local markets. Colonists traded cloth, guns, and metal tools to the Indians for furs and hides. In some years, certain individual colonies might ship as many as 40,000 deerskins to Europe.

Colonial ships carried rum to Africa and grain and livestock to the West Indies. In Africa, the rum was exchanged for slaves. In the West Indies, colonial products were traded for slaves, sugar, and molasses, which was used to make rum. This trade pattern among the mainland colonies, Africa, and the West Indies is sometimes called *triangular trade.*



Granger Collection

A colonial silversmith's shop, *above,* was the scene of a bustle of activity as silver was molded or hammered into shape. Some colonial towns became centers for silversmithing.

Some colonial ships followed another triangular trade route. These ships carried fish, lumber, meat, and grain to southern Europe, wine and fruits to England, and manufactured goods back to the colonies.

Money was scarce in the American Colonies. The English government did not allow coins to be exported from England or to be minted in the colonies. As a result, the colonists were often short of cash.

Instead of money, the colonists used a variety of forms of payment for goods. They used *barter*—that is, the direct exchange of goods or services without the use of money—for some local transactions. They also kept *book accounts,* which let people pay for goods and services over time with their own goods and services.

Barter was the main method of exchange in the fur trade with Indians. Beaded necklaces or belts known as *wampum* sometimes were used in the Indian trade. Occasionally, colonists traded wampum belts among themselves.

At one time or another, colonial governments accepted *commodity money* as a form of payment of taxes. Commodity money included beef, pork, corn, rice, flax, and certain other farm products that were assigned a certain value.

Various certificates and documents were also used as money. For example, some planters in Maryland and Virginia used tobacco certificates as money. These certificates showed that the planters had tobacco of a certain value stored in a public warehouse. The person who received such a certificate had the right to export the tobacco. After 1700, mortgages and loans expanded colonial credit and created an investment market.

The colonists also used any foreign money they could get. Many of the coins in the colonies were Spanish gold or silver money, including dollar pieces. The coins came to the colonies in trade from the West Indies and were given a value in terms of English pounds, shillings, and pence.

From 1652 to 1682, Massachusetts produced several kinds of silver coins despite an English law that said only the monarch could issue coins. Coins issued by Massachusetts included the *pine-tree shilling* and the

oak-tree shilling. The colony stamped the date 1652 on all coins that were circulated, no matter when they were made. In 1652, there was no monarch in England. In this way, the colonists could claim the coins were minted at a time when royal authority did not exist and therefore were legal. In the 1700's, several colonies issued paper money that they accepted for payment of taxes. Shortly before the Revolutionary War in America, England passed several laws to stop this practice.

Joan R. Gundersen

Related articles. For the history of each colony, from settlement to statehood, see the separate state articles in ***World Book,*** such as Maryland (History). See also:

Colonization and colonial settlements

Canada, History of
Dutch West India Company
Jamestown
Latin America (History)
London Company
Lost Colony
Massachusetts Bay Colony
Mission life in America
New England, Dominion of
New England Confederation
New France
New Netherland
New Sweden
Ohio Company
Plymouth Colony
Plymouth Company
United States, History of the (The colonial heritage)
Williamsburg

Government and law enforcement

Blue laws
Ducking stool
House of Burgesses
Mayflower Compact
Pillory
Stocks
Town meeting

Education and communication

American literature (Colonial literature [1608-1764])
Bay Psalm Book
Book (picture: The *Bay Psalm Book)*
Education (Development of U.S. education)
Freedom of the press
Hornbook
Literature for children (The Puritans)
Poor Richard's Almanac
Postal Service, United States (Colonial times)
School (Colonial schools)
Town crier

Biographies

The New England Colonies

Alden, John and Priscilla
Andros, Sir Edmund
Billings, William
Bradford, William (1590-1657)
Bradstreet, Anne
Brewster, William
Carver, John
Copley, John Singleton
Cotton, John
Dudley, Thomas
Dyer, Mary
Eaton, Theophilus
Edwards, Jonathan
Eliot, John
Endecott, John
Faneuil, Peter
Goddard, Mary Katherine
Goddard, William
Hooker, Thomas
Hutchinson, Anne Marbury
Massasoit
Mather, Cotton
Mather, Increase
Mather, Richard
Philip, King
Randolph, Edward
Revere, Paul
Samoset
Sewall, Samuel
Shirley, William
Squanto
Standish, Miles
Stuart, Gilbert Charles
Taylor, Edward
Uncas
White, Peregrine
Wigglesworth, Michael
Williams, Roger
Winslow, Edward
Winthrop, John
Winthrop, John, Jr.
Wise, John

The Middle Colonies

Bradford, William (1663-1752)
Bradford, William, III
Feke, Robert
Franklin, Benjamin
Jemison, Mary
Johnson, Sir William
Minuit, Peter
Pastorius, Francis Daniel
Penn, William
Stuyvesant, Peter
Tennent, Gilbert
Tennent, William
Van Rensselaer, Kiliaen
West, Benjamin
Woolman, John
Zenger, John Peter

The Chesapeake and Southern colonies

Bacon, Nathaniel
Berkeley, Sir William
Byrd, William, II
Calvert, Cecilius
Calvert, Charles
Dare, Virginia
De La Warr, Lord
Dinwiddie, Robert
Oglethorpe, James
Peale (family)
Pinckney, Elizabeth Lucas
Pocahontas
Powhatan
Rolfe, John
Smith, John
Spotswood, Alexander

Other related articles

African Americans (Colonial times)
Antique
Bacon's Rebellion
Charter Oak
Claiborne's Rebellion
Colonialism
Flag (pictures: Flags in United States history)
French and Indian wars
Georgian architecture
Great Awakening
Indentured servant
Indian wars
Mayflower
Mercantilism
Molasses Act
Money (History of United States currency)
Navigation Acts
Patroon system
Pennsylvania Dutch
Pilgrims
Pine-tree shilling
Pioneer life in America
Plymouth Rock
Puritans
Revolutionary War in America
Salem (Massachusetts)
Salem witchcraft trials
Shot tower
Slavery (Slavery in the United States)
Spinning
Stamp Act
Thanksgiving Day
Witchcraft

Outline

I. Why the colonists came to America
- A. Economic reasons
- B. Religious and political reasons

II. Before the arrival of the European settlers

III. Early English settlements
- A. Jamestown
- B. Plymouth Colony

IV. Development of the Thirteen Colonies
- A. English expansion
- B. Geographic divisions
- C. Changes in colonial control
- D. Population growth
- E. Commercial expansion

V. Colonists and Indians
- A. Effects of contact on the Indians
- B. The struggle for land

VI. The structure of colonial society
- A. The gentry
- B. The middle class
- C. The lower class

VII. Government and law enforcement
- A. Colonial government
- B. Local government
- C. Voting and other rights
- D. Crime and punishment

VIII. Colonists at home
- A. Houses
- B. Furnishings
- C. Clothing
- D. Food and drink
- E. Recreation

IX. Education and religion
- A. Education
- B. Religion

X. Transportation and communication
A. Transportation
B. Communication
XI. Arts
A. Literature
B. Painting
C. Decorative arts
D. Music
XII. Science, health, and medicine
A. Science
B. Health and medicine
XIII. The economy
A. Farming
B. Fishing and whaling
C. Lumbering and shipbuilding
D. Ironmaking
E. Other industries
F. Trade
G. Money

Questions

What were some of the reasons Europeans headed for the New World?
How did the English colonists in the New World differ from the Spanish and French settlers?
Why were the Middle Colonies known as the "bread colonies"?
In what ways did the arrival of the colonists from Europe affect the Indians?
What was the purpose of the Proclamation of 1763?
What was *mercantilism*? What effects did it have on colonial trade?
What were the *slave codes*? Why were they important?
Why did the gentry hold most elected positions in the colonies?
What were the main kinds of food consumed by the colonists? The most common drinks?
How did changes in the topics in colonial publications through the years reflect the changing concerns of the colonists?
What are some ways the designs of houses differed among the colonies?

Additional resources

Level I
Carlson, Laurie M. *Colonial Kids: An Activity Guide to Life in the New World.* Chicago Review Pr., 1997.
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Colonialism is the policy or practice by which one country installs a settlement of its people on the lands of another society. Usually, a colonizing country also quickly establishes political control over the other society. Colonialism is generally associated with the European overseas expansion that began about 1500. But it has occurred in most parts of the world and in most historical eras, even the most ancient.

Through the centuries, nations have established colonies primarily for economic reasons. For example, nations have set up colonies to gain privileged access to prized manufactured items, to obtain opportunities for profitable investments, to secure access to raw materials, or to provide markets for their goods. They have also sent out colonists to search for precious metals or to trade for scarce and valuable spices and specialized crops. In some cases, religious organizations strongly supported colonization efforts as a way of gaining converts among nonbelievers. However, religious conversion of native peoples rarely ranked as the primary reason for colonization.

Colonizing powers often possessed superior technologies or at least had advanced military weapons or tactics. For example, the Spanish expeditions against the Indians of Central and South America during the 1500's succeeded in part because the Spaniards had superior weapons. Their metal swords and armor and their muskets gave them a great advantage over the Indians, who had never developed such weapons.

Colonialism is similar to *imperialism,* which involves one country having political or economic control over another society. The two are often associated because imperial powers typically establish colonies in societies they control. See **Imperialism.**

History of colonialism

Ancient colonialism. Starting about 1100 B.C., the Phoenicians, who were based in what are now roughly the coastal areas of Syria, Lebanon, and Israel, established themselves as the dominant traders in the Mediterranean region. As they sailed along the Mediterranean shores, they founded numerous colonies, including Utica and Carthage in northern Africa. In the 500's B.C., the Phoenicians came under the rule of the Persian Empire. Carthage then dominated the more distant Phoenician colonies in the western Mediterranean.

The Roman Empire, which began about 264 B.C., was the greatest colonial empire of the ancient world. At its height in the A.D. 100's, it ranged from northern Britain to the Persian Gulf and included much of northern Africa. In 395, following a period of disorder, the empire was permanently divided into two parts, with capitals in Rome in the west and Constantinople (now Istanbul, Turkey) in the east. The Western Roman Empire is generally considered to have ended in 476, when Germanic invaders overthrew Romulus Augustulus, the last ruler of the empire. The East Roman Empire survived as the Byzantine Empire until 1453, when the Ottomans captured Constantinople.

Early European colonialism. In the 1400's, Portugal and Spain repeatedly sent ships into the eastern Atlantic Ocean in search of new sources of wealth and trade. In the late 1400's, Portuguese colonists began to settle on the islands of São Tomé and Príncipe off the west coast of Africa. The Portuguese developed sugar plantations on these islands and on others they colonized along the coast. They then traded for African slaves, whom they used as the labor force on the plantations.

Also in the late 1400's, Spain established a colony on the Canary Islands. The Spaniards conquered the people of the islands and forced them to work on sugar plantations that the Spaniards developed there. Spain established a permanent colony on the island of Hispaniola in the Caribbean Sea in 1494. As the Spaniards spread across the Caribbean islands, they set up cities and sugar plantations. As they had on the Canaries, the Spaniards forced the islanders to work on their enterprises.

The expedition led by the Spanish explorer Hernando Cortés conquered the Aztec Empire of Mexico from 1519 to 1521. The Spaniards went on to take control over the greater part of Central and South America. Brazil came under the control of the Portuguese, who had established a colony there in 1532. Spain also established frontier missions in parts of what are now the south-

western and southeastern United States.

During the 1600's, the Dutch, English, French, and Swedes founded colonies in eastern North America, where they competed for land and riches. In 1763, the British gained control of nearly all of North America from the Atlantic Ocean to the Mississippi River.

The Dutch colonized the Spice Islands (now part of Indonesia) beginning in the 1600's. Most early Dutch settlers were based in the colonial capital of Batavia (now Jakarta) on Java. The Dutch also established a settlement at Cape Town on the southern coast of Africa in 1652.

Later colonialism. Eventually, the North and South American colonies came to feel culturally distinct from their mother countries and increasingly resented being ruled by them. The colonies' economies had developed, so they no longer relied on their founding nations for prosperity. The thirteen British North American colonies that became the United States declared their independence in 1776. Britain recognized them as independent in 1783. The rebellious slaves of French-controlled Haiti fought for over a decade before that country achieved independence in 1804. The mainland Latin American societies gained independence between 1818 and 1825. Cuba, however, remained a Spanish colony until 1898.

While colonialism declined in the Americas, however, it increased in Asia and Africa. In the 1780's, the British began to colonize parts of lightly populated Australia with convicts. At that time, several nations sent criminals to distant prison colonies. France began its conquest and settlement of Algeria in the 1830's.

In the 1870's, several European nations began a furious race for colonies in Africa, Asia, and the Pacific Islands. This rush for colonies was brought about in part by an increasingly bitter rivalry among Europe's most powerful countries.The United Kingdom, France, and Germany were the most active colonizers, but Italy, Spain, Belgium, and Portugal also took part. By the early 1900's, these countries had divided up all of Africa—except for Ethiopia and Liberia—among themselves. In the 1800's, the United Kingdom also expanded its control over India and what are now Malaysia and Myanmar. The French seized Indochina and some Pacific Islands.

New colonizing nations appeared at the end of the 1800's and the beginning of the 1900's. The United States acquired Guam, Hawaii, the Philippines, and Puerto Rico. Japan took over Korea and Taiwan, took control of a large part of northern China, and occupied some Pacific Islands. After its defeat in World War II (1939-1945), Japan lost all of these possessions, though it later regained some of the islands.

Decolonization. Large-scale colonialism came to an end during the 30 years following World War II. Many colonies won their independence peacefully. Others, including Algeria, Kenya, and Vietnam, engaged in armed uprisings to achieve self-government.

Various factors contributed to the rapid decolonization of the mid-1900's. For example, most peoples of the world had come to believe in self-determination, democracy, and human rights. Most colonies had developed a sense of nationalism and an educated native class of administrators and professionals. Colonies had also become economic burdens for the European powers who wanted to concentrate on their own reconstruction after the vast destruction of the war. In addition, non-Communist colonial powers, such as the United Kingdom and France, feared that if they did not grant their colonies freedom, the colonies might side with the powerful Communist countries of the Soviet Union and China and begin radical uprisings.

Today, several countries, including the United Kingdom, France, and the United States each control a few island dependencies in the Pacific Ocean or Caribbean Sea. In many of these small societies, the residents have voted to remain dependencies.

Colonialism has nearly disappeared, but some people believe many of its features remain in the form of *neocolonialism.* Neocolonialism is the informal political and economic domination of less developed countries by wealthy nations.

Colonial rule

The policies of countries toward their colonies varied greatly over the centuries and in different parts of the world. The lasting impact of colonialism on modern nations that were once colonies also has varied.

Colonial economic policies. Colonizing nations sought to prosper from their colonial possessions. They often taxed their colonies heavily and placed limits on colonial trade and production.

From the 1500's to the 1700's, a number of countries followed an economic policy called *mercantilism.* Under mercantilism, a nation's wealth was measured by the precious metals it accumulated through favorable balances of trade with its dependencies and with other countries. The mother country would ship finished manufactured items and agricultural products to the colonies in exchange for silver and gold, raw materials that the mother country could make into manufactured goods, or valued products that the mother country could sell for a profit. This approach depended heavily on governmental regulation of the economy and greatly limited free trade. In many cases, colonizing nations also required ships sailing to and from the colonies to pass through the ports of the mother country, no matter what the final destination.

Colonial powers also sought to benefit from the resources and labor of the native peoples. A substantial source of state income in the Spanish American colonies was the obligation for each adult male Indian to give *tribute* (forced payment) to the colonial government. Government regulations also forced this same population to work for little or no pay for a certain number of days on farms or in mines run by the colonizers.

In some colonies of the New World, the European powers set up plantations on which they grew mainly sugar, tobacco, and *indigo,* a plant used to make blue dye. To provide cheap labor for the plantations, the European powers established the Atlantic slave trade.

Under some colonial systems, colonies were forbidden from competing with the mother country in certain industries. In addition, some countries taxed products that the colonized population consumed.

To make the economy more efficient, colonial powers typically constructed modern communication and transportation systems. In many cases, they also improved medical and public health facilities. Although these endeavors helped the colonized peoples, their primary purpose was to further the colonizers' control over local

resources and laborers. Colonists rarely hesitated to take land away from the native people to use for private commercial purposes, nor did colonial governments typically prevent them from doing so.

Colonial government. Ruling nations sought to send citizens from the mother country to the colonies to serve as administrators. They expected that such officials would be more loyal than would local people. But through the years, the number of local people named as officials increased. Particularly before the late 1800's, the long distance separating most colonies from their mother countries and the slowness of communication and transportation made most colonial administrations virtually independent. In many cases, local colonial administrators often chose which policies issued from the mother country would be enforced.

Effects of colonialism

The effects of colonialism are still felt today. For example, the official language of many former colonies is that of the mother country. In general, colonialism had long-term economic, political, and social effects.

Economic effects. Colonial policies prevented or discouraged colonies from industrializing or expanding the kinds of products they turned out. Instead, most colonies remained dependent on the production of a limited number of raw materials. Trade regulations and tariffs generally limited exports only to the home country, and then at unfavorable terms of trade. Few, if any, native people had opportunities to become business leaders. Consequently, with the end of colonialism, many former colonies remained economically dependent on their mother countries.

Many native people were stripped of their lands and forced into unfavorable wage-earning employment or unequal tenant farming contracts with estate owners. Numerous others migrated to the new cities that sprang up under colonialism to work for scant wages. Even improvements in public health hurt the colonized people economically, because the population grew at a rapid pace. As a result, an abundance of laborers competed for a small number of jobs and unemployment grew.

Political effects. Colonialism often ended petty wars and local rivalries. But it could create largely artificial countries, binding together different peoples who might have little in common. In many cases, especially in the British colonies in Africa, the colonial government ruled the people through traditional chiefs and other local leaders. But few native people, even those educated at European universities, received administrative positions with any real authority at the colonial level. Therefore, the people often had little experience in governing when they gained independence.

Even colonizing countries of the 1800's and 1900's that claimed to support democracy, civil rights, and free elections often permitted only political movements that favored them in their dependencies. Because of colonial policies, many countries had little experience with democratic institutions when they became independent.

Social effects. The public and church schools set up in colonies generally emphasized the culture of the colonial power and sought to instill ideas favorable to colonialism in the population. Missionaries sought to persuade the native peoples that the religion of the colonizers was superior to their traditional religions. In addition, colonial authorities often sought to agitate ethnic or religious groups against one another to consolidate their own power. In what are now Rwanda and Burundi in Africa, German and, later, Belgian colonial policies deepened traditional divisions between the Tutsi and the Hutu ethnic groups. Violent clashes between those two groups still occur today. John E. Kicza

Related articles in *World Book*. See the *History* section of the articles on countries mentioned in this article. See also:

Africa (History)
Asia (History)
Berlin Conference
Canada, History of
Colonial life in America
Colony
Commonwealth of Nations
East India Company
Enclave
Europe (Colonial expansion)
Exploration
Governor general
Immigration
Imperialism
Latin America (Colonial rule)
Mandated territory
Mercantilism
Minority group (How a group becomes a minority)
Muslims (Colonialism)
Nationalism
Phoenicia
Racism (History)
Territory
Trust territory
United States, History of the
World, History of the
World War I (Competition for colonies)

Additional resources

Barringer, Tim J., and Flynn, Tom, eds. *Colonialism and the Object*. Routledge, 1998.
Gikandi, Simon. *Maps of Englishness*. Columbia Univ. Pr., 1996.
Harshé, Rajen. *Twentieth Century Imperialism*. Sage, 1997.
Keay, John. *Empire's End: A History of the Far East from High Colonialism to Hong Kong*. Scribner, 1997.
Louis, William R., and others, eds. *The Oxford History of the British Empire*. 5 vols. Oxford, 1998-1999.

Colony. See Animal (Animal homes and communities).

Colony is a settlement established by people outside their native land, and ruled by the mother country. Nations establish colonies to find more room in which people can live, to increase trade by providing a market for manufactured goods, to gain sources of raw materials, to secure military advantages, and to increase the prestige of the mother country.

Climate has often decided how a colony develops. Temperate lands, such as the areas that are now the United States, Canada, and Australia, have attracted large numbers of colonists who have pushed out the inhabitants of the region. Elsewhere, especially in Latin America, the colonists created new multiracial societies. Outside of the Western Hemisphere, tropical colonies attracted few colonists. These few, instead of pushing out the inhabitants of the region, took control of the colonized territory, as the Belgians did in the Belgian Congo in Africa.

Colonies in time became independent of the mother country. For example, the American Colonies broke away from Britain and became the United States. Canada, Australia, New Zealand, and India were once British colonies. But they are now independent members of the Commonwealth of Nations, an association of nations that includes Britain and many of its former possessions. A number of former French colonies, such as Senegal, have joined France as members of the French Community. Almost half the members of the United Nations are former colonies that have become independent since World War II (1939-1945). Allen J. Greenberger

See also Colonialism and its list of *Related articles*.

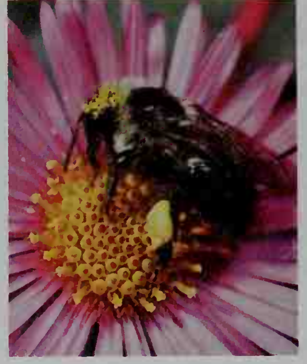
Colony, Penal. See Penal colony.



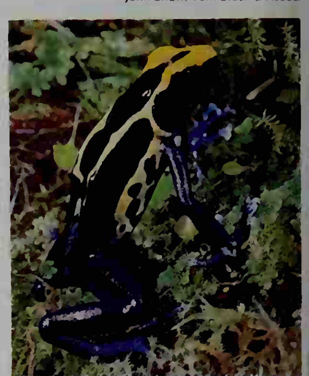
John Shaw, Tom Stack & Assoc.



H. Armstrong Roberts



Dwight R. Kuhn, Bruce Coleman Inc.



Zig Leszczynski, Animals Animals

The great variety of colors in nature includes the dazzling colors of autumn leaves, *top,* and the appetizing colors of ripe fruits and vegetables, *above left.* A brightly colored flower, *above center,* attracts a honeybee to its pollen. The brilliant blue and yellow of a South American arrow poison frog, *above right,* serve as a vivid warning to the animal's enemies.

Color

Color fills our world with beauty. We delight in the colors of a magnificent sunset and in the bright red and golden-yellow leaves of autumn. We are charmed by gorgeous flowering plants and the brilliantly colored arch of a rainbow. We also use color in various ways to add pleasure and interest to our lives. For example, many people choose the colors of their clothes carefully and decorate their homes with colors that create beautiful, restful, or exciting effects. By their selection and arrangement of colors, artists try to make their paintings more realistic or expressive.

Color serves as a means of communication. In sports, different colored uniforms show which team the players are on. On streets and highways, a red traffic light tells drivers to stop, and a green light tells them to go. On a map printed in color, blue may stand for rivers and other bodies of water, green for forests and parks, and black for highways and other roads.

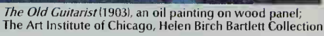
We use the names of colors in many common expressions to describe moods and feelings. For example, we say a sad person *feels blue* and a jealous one is *green with envy.* We say an angry person *sees red.* A coward may be called *yellow.*

Color plays an important part in nature. The brilliant colors of many kinds of blossoms attract insects. The insects may pollinate the flowers, causing the plants to develop seeds and fruits. Colorful fruits attract many kinds of fruit-eating animals, which pass the seeds of the fruits in their droppings. The seeds may then sprout wherever the droppings fall. In this way, fruit-bearing plants may be spread naturally to new areas.

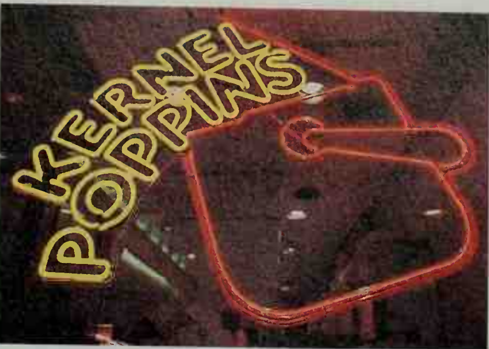
The colors of some animals help them attract mates. For example, a peacock spreads his brightly colored feathers when courting a female. The colors of many

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The Old Guitarist (1903), an oil painting on wood panel;
The Art Institute of Chicago, Helen Birch Bartlett Collection



D. P. Hershkowitz, Bruce Coleman Inc



Focus on Sports

Communicating with color. Color is often used to express moods and to communicate information. The use of blues in Pablo Picasso's painting *The Old Guitarist, above left,* creates a sad and lonely feeling. The exciting colors of a neon sign, *upper right,* capture people's attention. The colors of football uniforms, *lower right,* help spectators tell which team the players are on.

other animals help them escape from enemies. For example, Arctic hares have brownish fur in summer. In winter, their fur turns white, making it difficult for enemies to see the hares in the snow.

Although we speak of seeing colors or objects, we do not actually see them. Instead, we see the light that objects reflect or give off. Our eyes absorb this light and change it into electrochemical signals. The signals travel through nerves to the brain, which interprets them as colored images. However, there is much that scientists still do not know about how our eyes and brain enable us to sense color.

The relation between color and light

To understand how we see color, we must first know something about the nature of light. Light is a form of energy that behaves in some ways like waves. Light waves have a range of *wavelengths.* A wavelength is the distance between any point on one wave and the corresponding point on the next wave. Different wavelengths of light appear to us as different colors. Light that contains all wavelengths in the same proportions as sunlight appears white. See **Light.**

When a beam of sunlight passes through a specially shaped glass object called a *prism,* the rays of different wavelengths are bent at different angles. The bending breaks up the sunlight into a beautiful band of colors. This band contains all the colors of the rainbow and is called the *visible spectrum.* At one end of the spectrum, the light appears as violet. It consists of the shortest wavelengths of light that we can see. Farther along the spectrum, the light has increasingly longer wavelengths. It appears as blue, green, yellow, orange, and red, each shading into its neighboring colors in the spectrum. The longest wavelengths of light that we can see appear deep red in color.

Light waves are a form of *electromagnetic waves,* which consist of patterns of electric and magnetic energy. The visible spectrum is only a small part of the *electromagnetic spectrum*—the entire range of electromagnetic waves. Beyond the violet end of the visible spectrum are ultraviolet rays, X rays, and gamma rays.

The visible spectrum A band of colors called the *visible spectrum* forms when white light passes through a *prism* (a specially shaped glass object). The prism bends the shortest light waves most. They appear violet. It bends the longest waves least. They appear red. All other colors lie in between. Ultraviolet and infrared fall outside the spectrum and are invisible to people. The length of light waves is measured in *nanometers*. One nanometer is a billionth of a meter, or about $\frac{1}{25,000,000}$ of an inch.

WORLD BOOK illustration by Leonard Morgan

Ultraviolet — Visible spectrum — Infrared

Nanometers 400 450 500 550 600 700

Prism

White light

Beyond the red end of the visible spectrum are infrared rays and radio waves. See **Electromagnetic waves**.

Such objects as traffic lights and neon signs appear colored because the light that they give off contains a limited range of wavelengths. However, most objects appear colored because their chemical structure absorbs certain wavelengths of light and reflects others. When sunlight strikes a carrot, for example, molecules in the carrot absorb most of the light of short wavelengths. Most of the light of longer wavelengths is reflected. When these longer wavelengths of light reach our eyes, the carrot appears orange.

An object that reflects most of the light of all wavelengths in nearly equal amounts appears white. An object that absorbs most of the light of all wavelengths in nearly equal amounts appears black.

How we see color

The roles of the eyes and brain. Our ability to see color depends on many highly complicated workings of the eyes and brain. When we look at an object, light coming from the object enters our eyes. Each eye focuses the light, forming an image of the object on the *retina*. The retina is a thin layer of tissue covering the back and sides of the inside of the eyeball. It contains millions of light-sensitive cells. These cells absorb most of the light that falls on the retina and convert the light to electrical signals. These electrical signals then travel through nerves to the brain.

The retina has two main types of light-sensitive cells—*rods* and *cones*. The cells are named after their shapes. Rods are extremely sensitive to dim light but cannot distinguish wavelengths. For this reason, we see only tones of gray in a dimly lit room. As the light becomes brighter, the cones begin to respond and the rods cease functioning. The retina of a person with normal color vision has three types of cones. One type responds most strongly to light of short wavelengths, which corresponds to the color blue. Another type reacts chiefly to light of middle wavelengths, or green. The third type is most sensitive to light of long wavelengths, or red.

The brain organizes nerve signals from the eye and interprets them as colored visual images. Exactly how





WORLD BOOK photos by Larry McCann

Color vision requires a certain level of lighting. In dim light, colored objects, such as marbles, *above left*, appear gray. In bright light, the same objects, *above right*, appear in color.

the brain makes us aware of colors is still much of a mystery. Scientists have developed several theories to explain color vision. Some of these theories are discussed in the section *History of color studies.*

Some people do not have full color vision. Such people are said to be color blind. There are different types and degrees of color blindness, depending on different abnormalities in the retina's cones. In severe cases, one type of cone may be absent or not functioning. People who have such an abnormality confuse certain colors with others. Very few people cannot see colors at all. Most color-vision problems are inherited and cannot be cured. See **Color blindness.**

Surprising color-vision effects. Many operations of the eyes and brain work automatically and almost instantly in providing us with color vision. We have learned unconsciously not to "see" certain visual effects of these operations, especially as our eyes adjust to changes of color. When we do become aware of such effects, they may seem dramatic or startling. Some of the color-vision effects that we normally do not notice can be easily demonstrated.

We can demonstrate one color-vision effect by covering half a sheet of brightly colored paper with plain white paper. If we stare at the colored area for about 30 seconds and then remove the white paper, the area that had not been covered will seem much lighter than the half that had been covered. It seems lighter because our eyes *adapt to* (become accustomed to) colors. Such a visual effect is called *chromatic adaptation.*

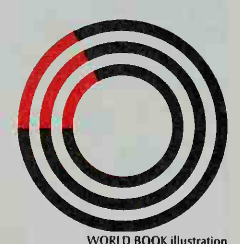
If we stare at a colored image for about 30 seconds and then look at a white surface, we see an *afterimage.* The afterimage has the same shape as the original image but different colors. Where the original image was red, the afterimage will be green. Where the image was green, the afterimage will be red. Blue areas become yellow, and yellow areas become blue. Black and white also reverse. The technical name for this amazing color-vision effect is *successive contrast.*



To see an afterimage, stare at the center of the flag for about 30 seconds. Then look at a sheet of white paper. You will see an image of the flag with its proper colors.







WORLD BOOK illustration

Phantom colors are colors that appear in areas that are only black and white. A faint area of phantom pink can be seen in the center of the triangle formed by the three circles above.

We can also demonstrate that the appearance of a color is influenced by surrounding colors. If we place the same color against different background colors, the color will look different in each case. In addition, a color appears lighter when surrounded by a dark background than when surrounded by a light background. This color-vision effect is called *chromatic induction* or *simultaneous contrast.*

Sometimes, we may see colors in areas that are only black and white. Such colors are called *phantom colors.* Phantom colors may be seen by staring at flashing black-and-white patterns, such as those produced by a rapidly rolling black-and-white television picture.

Color vision in animals

Apes, monkeys, many kinds of birds, and some species of fishes have color vision much like ours. However, numerous other animals see colors differently from the way we do. For example, research shows that crocodiles see colors as various shades of gray. The eyes of certain other animals are sensitive to light that we cannot see. For example, bees can see ultraviolet light, which is invisible to people. On the other hand, bees cannot see the color red.

Methods of color production

Manufacturers, artists, and craftworkers produce objects in a tremendous variety of colors. To create so many different colors, they use one of two basic methods. These methods are (1) mixing colorants and (2) mixing colored lights.

Mixing colorants. A great variety of colors can be created by mixing *colorants.* Colorants are chemical substances that give color to such materials as ink, paint, crayons, and chalk. Most colorants consist of fine powders that are mixed with liquids, wax, or other substances to make them easier to apply to objects. Colorants that dissolve in liquids are called *dyes.* Colorants

that do not dissolve but spread through liquids or other substances as tiny solid particles are called *pigments.*

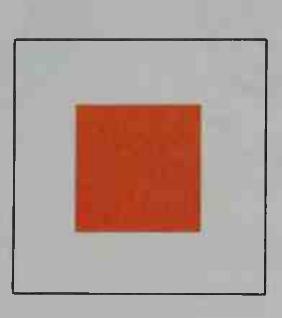
When two different colorants are mixed, a third color is produced. For example, when paint with blue pigment is mixed with paint that has yellow pigment, the resulting paint appears green. When light strikes the surface of this paint, much of it penetrates the paint layer and hits pigment particles. The blue pigment absorbs most of the light of long wavelengths—light that appears red, orange, and yellow. The yellow pigment absorbs most of the light of short wavelengths—light that appears blue and violet. Most of the light of medium wavelengths is not absorbed but reflected through the surface of the paint. When this light reaches our eyes, we see the paint as green. In a colorant mixture, each colorant absorbs, or subtracts, some of the wavelengths of light that strike it. For this reason, colorant mixtures are sometimes referred to as *subtractive color mixtures* or *color by subtraction.*

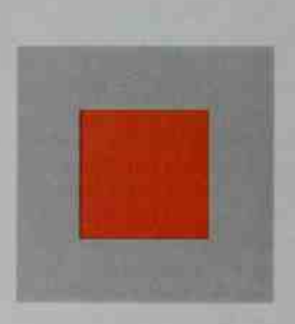
Any three colorants that can be mixed in different combinations to produce nearly any other color are known as *primary colorants* or *primary colors in paint.*

The effects of neighboring colors

The appearance of a color is influenced by the other colors around it. The same color looks different when it is placed against different background colors. In addition, in certain two-color combinations, the colors seem to mix, forming a third color. In some other combinations, however, the colors seem to clash, creating a sense of visual vibration.

WORLD BOOK illustrations





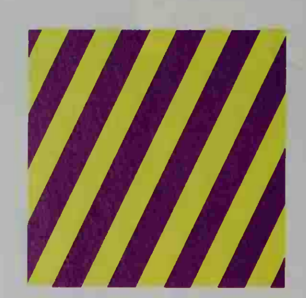




A color looks different against different background colors. The orange squares in the above illustrations are all the same color. But the orange seems lighter against the black background than against white or gray. It appears more yellow against green than against gray or white.



Visual mixing occurs when two colors seem to blend, forming a third color. Seen from a distance, the red and orange above seem to form a red-orange square.

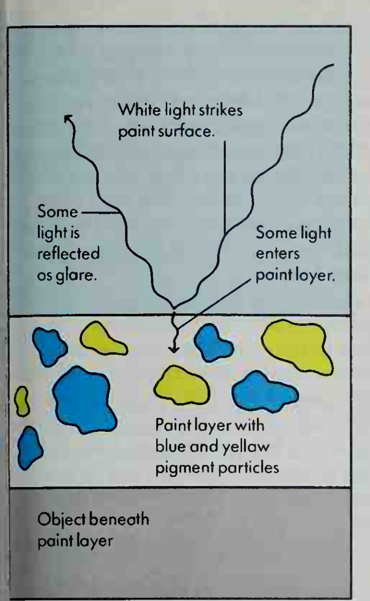


Visual vibration occurs when two colors seem to clash and vibrate in our vision. In the diagram above, the purple and yellow stripes appear to flash, dazzling our eyes.

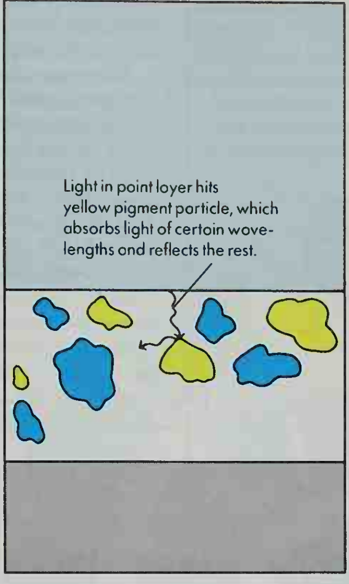
How a mixture of two pigments produces a third color

When light strikes *pigments* (coloring particles) in paint, the pigments absorb, or subtract, certain wavelengths of light and reflect others. In paint containing a mixture of different pigments, each pigment subtracts different wavelengths. Because the color we see depends on what wavelengths have been subtracted, producing colors by mixing pigments is called *color by subtraction.*

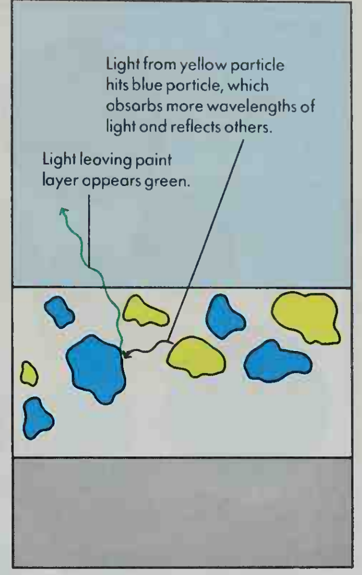
WORLD BOOK illustration



Light strikes the surface of a paint layer containing blue and yellow pigment particles. Some light is reflected as glare, and the rest penetrates the paint.



Light strikes a yellow particle, which absorbs, or subtracts, the light of short wavelengths and reflects the light of longer wavelengths.

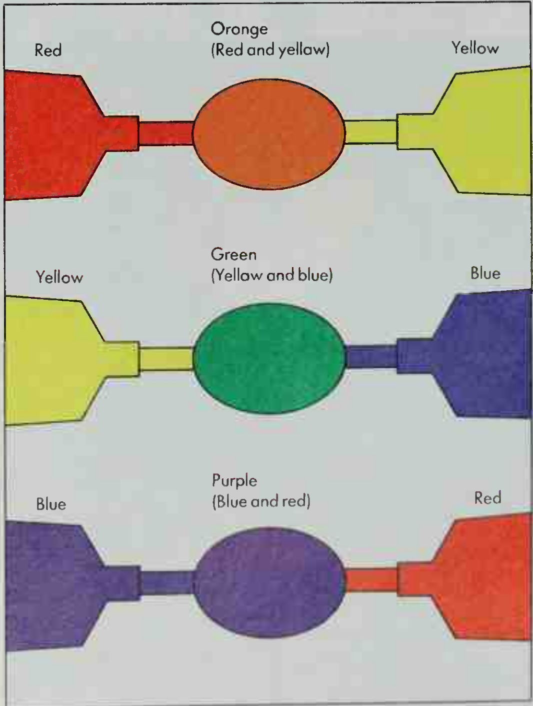


Light strikes a blue particle, which absorbs light of long wavelengths. Medium wavelengths are reflected from the paint and appear green to our eyes.

A common group of primary colorants consists of red, yellow, and blue. When primary colorants are mixed in pairs, the resulting colors are called *secondary colorants* or *secondary colors in paint.* Orange is formed by mixing red and yellow, green by mixing yellow and blue, and purple by mixing blue and red. Color experts have found that *magenta* (purplish-red), yellow, and *cyan* (blue-green) also make a good set of primary colorants. These three colorants can be mixed to produce an extremely wide range of colors.

Mixing equal amounts of three primary colorants results in a color that is almost black. However, special black colorants, such as a fine black powder called *carbon black,* provide better blacks. Mixing black with a color produces a *shade.* Primary colorants absorb much light, and so they cannot be mixed to produce very light colors. For such purposes, either a chemical compound called *titanium dioxide* or some other special white colorant must be added. Mixing white with a color produces a *tint.* The combination of black and white forms gray. Mixing gray with a color creates a *tone.*

Mixing colored lights. When lights of different colors are projected together onto a screen, they blend and form new colors. Mixing colored lights produces new colors differently from the way mixing colorants does. Mixing colorants results in new colors because each colorant subtracts some wavelengths of light. But mixing colored lights produces new colors by adding light of different wavelengths. For this reason, colored light mixtures are sometimes called *additive color mixtures* or *color by addition.*



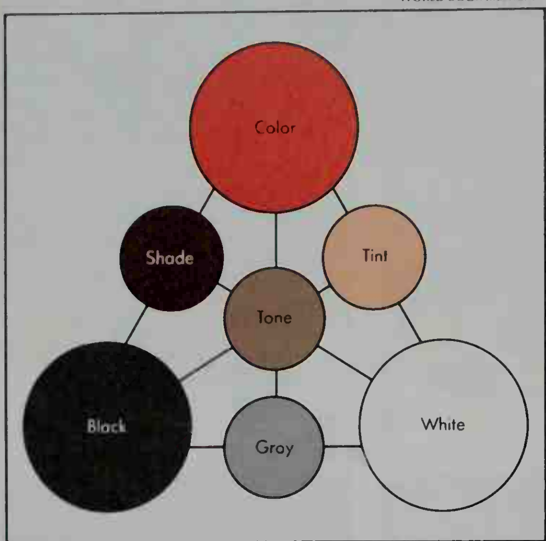
WORLD BOOK illustration by Zorica Dabich

Primary and secondary colors in paint. Red, yellow, and blue are common primary colors. They can be mixed to form the secondary colors orange, green, and purple, as shown above.

The color triangle

A color triangle has a color or white or black at each point. Adding white to a color produces a *tint.* Adding black forms a *shade.* Adding gray (a mixture of black and white) creates a *tone.*

WORLD BOOK illustration



In an additive color mixture, the primary colors differ from those in paint. The *primary colors in light* are red, green, and blue. When red and green lights are mixed, the result is yellow light. A mixture of blue and green lights forms blue-green light, and blue and red lights form purple light. Combining all three primary colors in light in the proper proportions results in white light.

The colors of any two lights are *complementary* if they form white light when mixed. Therefore, the complementary color of any primary color in light is the color formed by combining the two other primary colors. The complement of blue is yellow (red light plus green light). The complement of red is blue-green (blue light plus green light). The complement of green is purple (red light plus blue light).

Color television pictures are created by additive mixtures of the three primary colors in light. A color TV screen has thousands of tiny areas that glow when struck by a beam of electrons. Some areas produce red light, others produce green light, and still others produce blue light. When we watch a color program, we do not see each red, green, or blue area. Instead, we see a range of many colors produced when the red, green, and blue lights blend in our vision. We see white light when certain amounts of red, green, and blue light are combined. The combining of the primary colors to pro-

Mixing colored lights

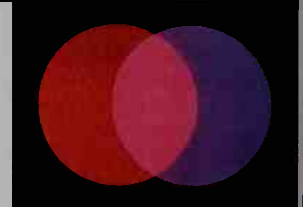
Lights of different colors are made up of different wavelengths. Projecting two different colored lights together onto a screen results in a new color because the wavelengths of one light are added to those of the other. For this reason, mixing colored lights is also called *color by addition.*

Primary colors in light

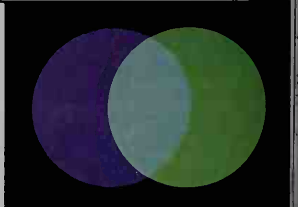
Red, green, and blue are the primary colors in light. They can be combined in various ways to form different colors. Combining all three primary colors results in white light.

Complementary colors in light

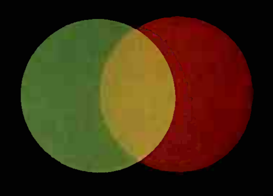
A blend of red and blue lights creates purple, the complement of green.



A blend of blue and green lights creates blue-green, the complement of red.



A blend of green and red lights creates yellow, the complement of blue.



WORLD BOOK photos by Arnold Ryan Challant & Associates

The complement of a primary color in light is produced by combining the two other primary colors. The colors that result from combining two primary colors in light are shown above.

duce white light makes it possible for a color TV to show black-and-white pictures. See Television (How television works).

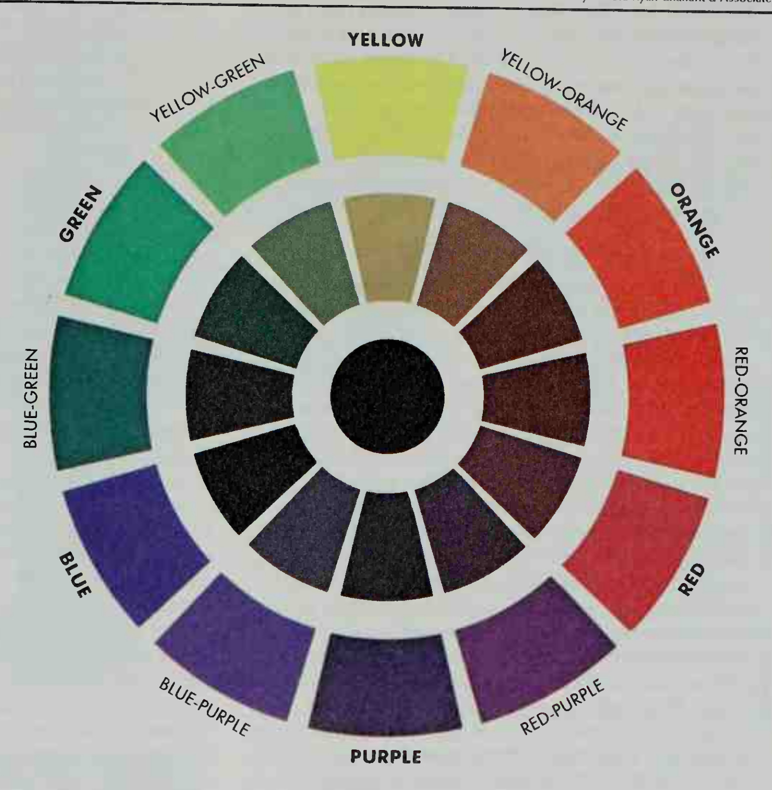
Producing color harmony

When neighboring colors have a pleasing effect, we say that they produce color harmony. In selecting clothes or decorating homes, many people consider what colors look good together. Artists and scientists have developed guidelines for combining colors. But there are no fixed rules of color harmony because too many factors affect whether colors go well together.

A *color circle,* or *color wheel,* shows the relations among colors. It is a helpful tool for choosing harmonious color combinations. A color circle consists of a range of colors in the form of a circle. The colors run from red, through the other colors of the spectrum, and back to red again. Three colors an equal distance apart on the color circle are called a color *triad.* The colors in a triad often go well together. The primary colors on the color circle—red, yellow, and blue—form a triad. The *secondary colors*—green, orange, and purple—are mix-

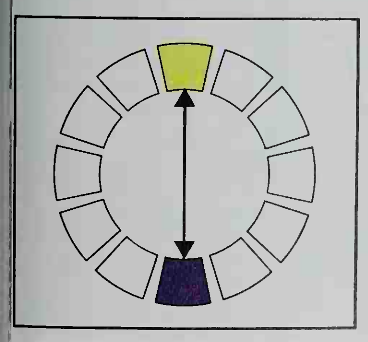
WORLD BOOK illustration by Arnold Ryan Chalfant & Associates

The color circle, also called the *color wheel,* indicates the relations among colors. The outer circle shows three primary colors (yellow, red, and blue) and three secondary colors (orange, purple, and green) labeled in boldface capital letters. They are separated by six intermediate colors labeled in lightface capitals. The inner circle shows darker colors obtained by mixing two colors that lie opposite each other in the outer circle.

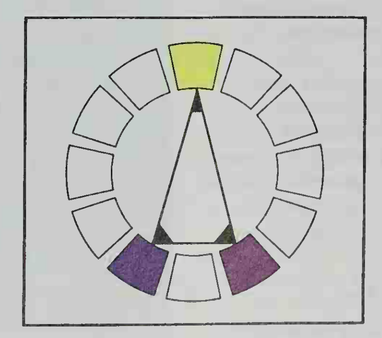


Harmonious color combinations

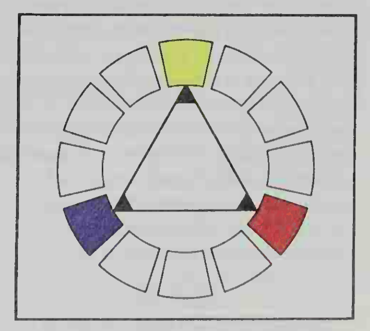
Certain colors have a pleasing effect when used together. The diagrams below show how harmonious color combinations can be found by connecting various positions on the color circle.



Complementary colors in paint, such as yellow and purple, lie directly opposite each other on the color circle.



Near-complementary colors, such as yellow and red-purple or yellow and blue-purple, lie nearly opposite.



A triad consists of three colors spaced an equal distance apart, such as the primary colors yellow, red, and blue.

tures of two primary colors. They lie at equal distances from the primary colors and also form a triad. *Intermediate colors* are mixtures of a primary and a secondary color. They lie between primary and secondary colors. A mixture of two secondary colors forms a *tertiary color.*

Any two colors that lie directly opposite each other on the color circle are called *complementary colors in paint.* Such pairs of complementary colors include red and green, orange and blue, and yellow and violet. Complementary colors often go well together. A color also may harmonize with colors that lie next to its complement, such as red with blue-green or yellow-green. Such colors are called *near-complementary colors* or *split complementary colors.* Colors that lie next to each other on the color circle, such as blue-green, blue, and blue-violet, also may form pleasing combinations. *Monochromatic* color schemes are made up of shades, tones, and tints of a single color. Such color combinations can create pleasant effects. For more information on producing color harmony, see **Interior design** (Color and light; Using color; pictures).

Characteristics of color

Every color has three basic characteristics. They are (1) hue, (2) lightness, and (3) chroma. Color experts describe an object's color in terms of these characteristics.

Hue is the property that gives a color its name—for example, red, orange, yellow, green, blue, or violet or a combination of such names. The dramatic differences that we see among the colors in the spectrum are produced by very slight differences in the wavelengths of light. For example, the wavelengths that appear as yellow are only slightly shorter than those that appear as orange. But there is a great visual difference between orange and yellow. This difference is a difference in hue.

Lightness is a measurement of the amount of light reflected from a colored object. The lightness of a color may be expressed by comparing the color's level of reflected light with that of samples on a lightness scale. A lightness scale runs from black, through shades of gray, to white. Black reflects very little light. A color that reflects about the same amount of light as black has a very low lightness level. Gray reflects more light than black. Thus, a color that reflects about the same amount of light as a shade of gray may have an intermediate level of lightness. White reflects nearly all the light that strikes it. Therefore, a color that reflects about the same amount of light as white has a very high lightness level. Color experts use the term *brightness* to describe the lightness level of a colored light source.

Chroma is a measurement of the *saturation* (concentration) of a color. For example, a teaspoon of red poster paint powder mixed with a teaspoon of water produces paint of a deep red color. The paint has a high concentration of red colorant, and so it has a high chroma. If we dilute the paint with a cup of water, the resulting mixture will have a low concentration of red colorant and, therefore, a low chroma.

How colors are classified

Experts estimate that we can distinguish perhaps as many as 10 million colors. Each color differs from all others in some degree of hue, lightness, or chroma. Our names for colors are far too inexact to describe accurately all the colors we see. As a result, people often have difficulty trying to describe or match a certain color. Matching colors is especially important in such industries as paint and textile manufacturing. Manufacturers of paints and textiles must minimize differences in the color of a particular paint or fabric from one batch of paint or bolt of fabric to another.

To overcome problems in describing and matching colors, color experts have developed various systems of classifying colors. Two widely used classification systems are (1) the Munsell Color System and (2) the CIE System of Color Specification.

The Munsell Color System is one of the most popular and useful means of classifying colors. It was developed in the early 1900's by Albert H. Munsell, an American portrait painter. The system classifies colors according to the three basic characteristics of hue, lightness, and chroma. However, Munsell used the term *value* for lightness.

The Munsell system may be displayed in many ways. A common display shows samples of different colors arranged around a vertical axis. Different hues are arranged around the axis like the spokes of a wheel, with each spoke consisting of a different hue. The axis serves as the value, or lightness, scale. It is divided into 10 sections. These sections correspond to 10 levels of value from black at the bottom, through shades of gray, to white at the top. All color samples at the same level have the same value. Colors close to the axis have low chroma. The farther from the axis a color is located, the higher is its chroma.

To match a particular color using the Munsell system or a similar system, one must find that color among the color samples provided. However, the number of samples in such systems cannot approach the number of colors we are able to distinguish. For this reason, it is sometimes impossible to find an exact color match.

The CIE System of Color Specification. Manufacturers of such products as foods, paints, paper, plastics, and textiles must often match colors precisely. Because color vision varies among people, two colors that match for one person may not match for another. For this reason, manufacturers do not rely on the human eye to match colors precisely. Instead, they use the CIE System of Color Specification. *CIE* stands for Commission Internationale de l'Éclairage (International Commission on Illumination), an international organization that establishes standards for measuring color.

A paint manufacturer who wants to produce the same color of green paint at two factories may use the CIE system to make sure that the two greens match. First, color experts analyze the color of the green paint made at one factory to determine the wavelengths of light that compose it. They make the analysis with a *spectrophotometer.* This instrument separates the light reflected from the paint into its various wavelengths and measures their *intensity* (strength). Then, tables of numbers are used to convert this information into three numerical values—one for each of the primary colors in light, which will match the original green when mixed. These tables of numbers, called *standard observers,* define the color-matching properties of a human eye having normal color vision.

The paint made at the second factory is also analyzed

The Munsell Color System

WORLD BOOK illustrations by Arnold Ryan Chalfant & Associates

White

The Munsell system classifies colors according to hue, chroma, and value. *Hues* are basic colors, such as reds and blues. *Chroma* is a measure of hue concentration, and *value* measures lightness. In the diagram at the left, the circular band shows hues with the same value and chroma. The horizontal band shows different levels of chroma in colors of constant hue and value.

Value

Chroma

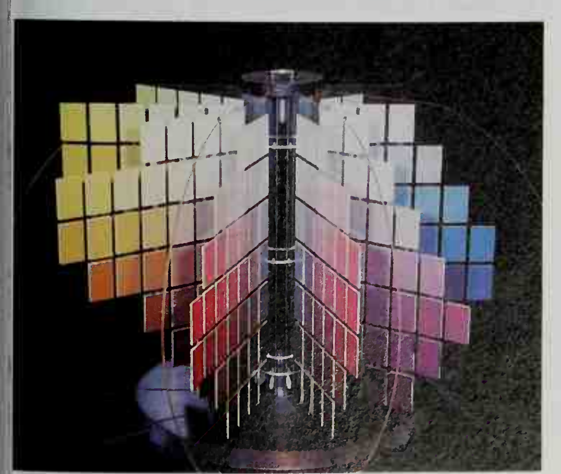
Hue

Black

Chroma

Value

Value and chroma are used to identify a large number of colors in a single hue, as shown in the diagram above. Colors that lie in a vertical line have the same chroma. Those that lie in a horizontal line have the same value.



Munsell Color, Baltimore

A Munsell color tree displays many color samples arranged around a central axis. Such a color tree can be helpful when a person is trying to match a particular color.

using a spectrophotometer. Small amounts of pigment are then added to adjust the color of the paint. Pigment is added until the analysis results in the same three primary color values that were produced by the paint made at the first factory. When these three primary color values are reached, the two green paints will match, even though they may contain different mixtures of pigments.

History of color studies

Early theories of color vision. Many thinkers in ancient times developed theories about the nature of color. Since then, scientific experiments have confirmed some of their ideas and disproved others.

Empedocles, a Greek philosopher of the 400's B.C., believed that color vision was caused by tiny particles that were given off by objects and passed through the eyes. He thought that the eyes either produced a color reaction to the particles or recognized them as colored. In the early 300's B.C., the Greek philosopher Plato proposed that color vision was caused by rays that shot out from the eyes toward objects. Aristotle, a Greek philoso-

pher of the later 300's B.C., may have been the first person to realize that there is a relation between color and light. However, he also thought that color was caused by something transparent between objects and the eyes. Galen, a Greek physician of the A.D. 100's, believed that color vision arose because rays from the eyes empowered the surrounding air to carry tiny images of objects to the eyes. He thought that these images then were analyzed by a visual spirit which moved between the eyes and the brain.

During the early 1000's, an Arab physicist, Ibn Al-Haytham, also known as Alhazen, recognized that vision is caused by the reflection of light from objects into our eyes. He stated that this reflected light forms optical images in the eyes. Alhazen believed that the colors we see in objects depend on the light striking the objects and on some property of the objects themselves.

Newton and Goethe. During the late 1600's and early 1700's, Sir Isaac Newton, an English scientist, performed many experiments to investigate the nature of color. Using a prism, Newton demonstrated that white light contains all the colors of the rainbow. He also was the first person to show that colored lights can be combined to form white light. Newton realized that light rays themselves are not colored but that the sensation of color is produced in the brain.

During the late 1700's and early 1800's, Johann Wolfgang von Goethe, a German poet, experimented with colored lights and shadows. He wrote a book on optics that seemed to contradict many of Newton's findings. Goethe did not believe that colored lights could be combined to form white light. He thought that all colored lights were actually mixtures of light and darkness. Goethe's experiments were useful in demonstrating many aspects of color vision. However, Goethe's theories of color vision based on these experiments are no longer accepted by scientists.

The three-component theory of color vision was proposed in 1801 by Thomas Young, an English physicist. It was further developed during the 1850's by a German physicist, Hermann von Helmholtz. The three-component theory is also known as the *Young-Helmholtz theory* or the *trichromatic theory.* The theory proposes that the eye has three types of fibers that are sensitive to different wavelengths of light. When light strikes the fibers, they generate electrical signals that travel directly to the brain. According to the three-component theory, the color sensations that arise in the brain correspond to the electrical signals in a simple and direct way. Scientific experiments have confirmed the existence of the three types of fibers, which are now called *cones.* Each type of cone is particularly sensitive to one of three general ranges of wavelengths of light—those corresponding to red, green, and blue.

The opponent color theory was proposed in 1874 by Ewald Hering, a German physiologist. Hering suggested that, somewhere in the nerves of the eyes and brain, there are two response mechanisms, each of which involves a pair of opposing colors. This means that the response mechanisms can signal only one of the two colors at a time. One response mechanism signals either red or green, and the other signals either yellow or blue. A third mechanism signals the level of lightness. The brain interprets these signals, producing our sense of color. The opponent color theory explains many aspects of color vision better than the three-component theory does. For example, the opponent color theory provides an explanation for the fact that we see no such colors as reddish-green or yellowish-blue.

Recent theories combine ideas from the three-component and opponent color theories to describe the various stages of color vision. In the first stage of color vision, three types of cones in the retina absorb light and generate electrical signals, as proposed by the three-component theory. During the second stage of color vision, nerves in the eyes and brain create three new signals, which correspond to those described by the opponent color theory. The nerve signals may pass through further stages before the brain finally interprets them as the sensation of color.

Gunter Wyszecki

Related articles in *World Book* include:

Animal (How animals protect themselves; pictures)
Color blindness
Dye
Electromagnetic waves
Eye
Interior design
Light
Newton, Sir Isaac
Paint
Pigment
Printing (picture: Printing with process colors)
Prism
Protective coloration
Rainbow
Spectrometer
Spectrum
Technicolor
Television (Creating television signals; Transmitting television signals; Receiving television signals)

Outline

I. **The relation between color and light**
II. **How we see color**
  A. The roles of the eyes and brain
  B. Surprising color-vision effects
III. **Color vision in animals**
IV. **Methods of color production**
  A. Mixing colorants
  B. Mixing colored lights
V. **Producing color harmony**
VI. **Characteristics of color**
  A. Hue
  B. Lightness
  C. Chroma
VII. **How colors are classified**
  A. The Munsell Color System
  B. The CIE System of Color Specification
VIII. **History of color studies**

Questions

What are the three basic characteristics of every color?
Why does a carrot appear orange?
Who was the first person to show that colored lights can be combined to form white light?
What is the *visible spectrum*?
How is a *tint* produced? A *shade*? A *tone*?
What are the three *primary colors in light*?
Why do we see only tones of gray in a dimly lit room?
What is a color *triad*?
Why are colorant mixtures called *subtractive color mixtures*?
What are *phantom colors*?

Additional resources

Level I

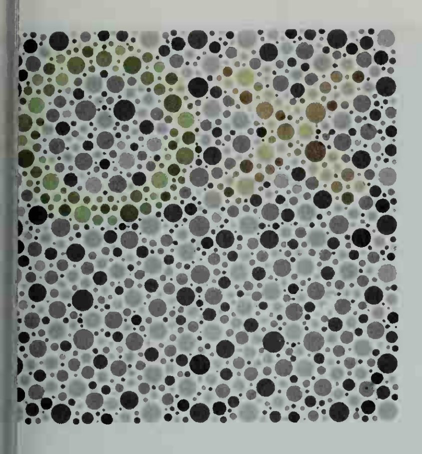
Burton, Jane, and Taylor, Kim. *The Nature and Science of Color.* Gareth Stevens, 1998.

Dorothy, Paul, and others. *The Magic Wand and Other Bright Experiments on Light and Color.* Wiley, 1995.

Level II

Lamb, Trevor, and Bourriau, Janine, eds. *Colour.* Cambridge, 1995.

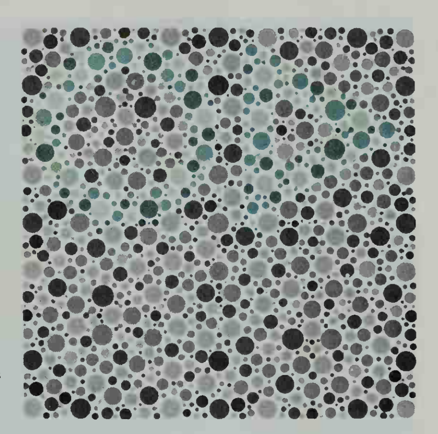
Nassau, Kurt. *Experimenting with Color.* Watts, 1997.



Testing color vision. These color patterns are examples of the figures used to find out whether people confuse certain colors with others.

At the left, people who confuse both blue and yellow may not see the ○ and ×.

At the right, people who confuse both red and green may not see the ○ and ▷.



Color blindness, sometimes called color vision deficiency, color defective vision, or daltonism, is the inability to tell all colors apart. The ability to see color originates in specific visual cells, called *cones,* in the retina of the eye. A person with normal color vision has three types of cones, and each type is sensitive to a different color. Color-blind people lack one, two, or all of these types of cones.

Most color-blind people have *dichromatic vision.* People with this kind of color blindness can see only yellows and blues. They confuse reds with greens, and some reds or greens with some yellows. Only a very few people are truly blind to all colors. They have *achromatic vision.* They see in shades of white, gray, and black—somewhat like a black-and-white photograph.

More men than women are color blind. About 8 of every 100 men are color blind, compared to about 1 of every 200 women. There is no cure for color blindness.

Many animals, including cats and horses, probably do not see colors as we do. But the condition is normal in their eyes, not defective.

Many color-blind people do not realize that their eyesight is defective. They have learned to use the color names that everyone else uses. These people may be hampered in their everyday activities, and their condition may place them in danger. If they confuse red and green, for example, they may only be able to tell traffic signals apart by their brightness. Many armed forces refuse to accept color-blind people for military service. In addition, color blindness can be a hindrance for airline pilots, fashion designers, and members of certain other professions.

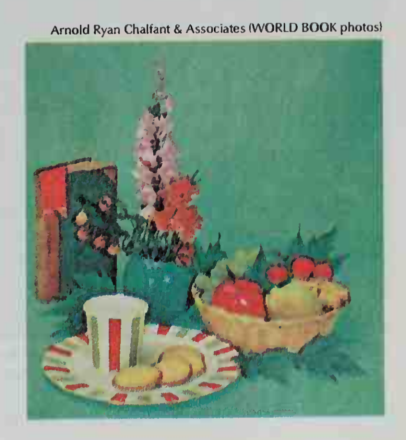
Most people can be easily tested for color blindness. The *Hardy-Rand-Rittler (H-R-R)* and *Ishihara* tests indicate both the type and the degree of color blindness. In these and similar tests, colored triangles, squares, and other shapes lie in a jumble of dots. These dots vary in both color and intensity. As the person identifies the colored shapes, an examiner can determine the person's ability to see colors. Other tests, such as the *Holmgren* yarn-matching test and the *Farnsworth-Munsell 100-hue* disk-matching test, measure the individual's ability to match colors.

Color blindness is inherited. If a color-blind man marries a woman who has no family history of color blindness, their children will have normal vision. Their daughters, however, will carry the gene for color blindness, and may pass it on to their children. If a woman whose father is color blind marries a man with normal vision, each of their sons has a 50-50 chance of inheriting the disorder. Injury to the retina or optic nerve and various diseases of the eye can also cause color blindness. Ramesh C. Tripathi and Brenda Tripathi

See also **Eye** (Color blindness).

Arnold Ryan Chalfant & Associates (WORLD BOOK photos)

To a color-blind person, some colors look the same. A person who confuses red and green with other colors may say these pictures look the same or are equally colorful. Most people with normal color vision would say the photograph on the right is the more colorful of the two.





Jeff Gnass, West Stock

Colorado's state flower, white and lavender columbine, blooms in the San Isabel National Forest in central Colorado. The three mountain peaks in the background are called the Three Apostles.

Colorado *The Centennial State*

Colorado is a state of unusual natural beauty in the Rocky Mountain region of the United States. The scenic wonders of the Rockies and the cool, pleasant climate make the state a center for summer tourists. In winter, the deep, powdery snow of Colorado attracts skiers to world-famous resorts. Each year, millions of visitors travel to such tourist areas as Aspen, Estes Park, and Colorado Springs.

But not all of Colorado is mountainous, and only part of the state's income comes from tourists. Most of the people of Colorado live and work on the dry, flat plains that make up the eastern two-fifths of the state. Tunnels bored through the mountains bring water to the plains for busy cities and prosperous farms. The state's location halfway between the major cities of California and the Midwest has helped make it the main transportation and distribution center for the Rocky Mountain region. Colorado's regional importance has led many large financial and manufacturing companies to set up branch offices in the state. Food processing and the manufacture of computer and electronic products are leading Colorado industries.

Herds of cattle and sheep graze on the mountains and plains of Colorado. Irrigated farms produce rich crops of potatoes and sugar beets. Wheat and corn fields spread across the plains. Fields of hay, which is used for cattle feed, can be found in most parts of the state.

Mining also has an important part in the state's economy. Gold and silver mining booms in the last half of the 1800's sparked Colorado's early growth and development. Mines in Colorado still produce gold and silver

The contributors of this article are John L. Dietz, Professor of Geography at the University of Northern Colorado, and Duane A. Smith, Professor of History at Fort Lewis College and coauthor of A Colorado History.

Interesting facts about Colorado

WORLD BOOK illustrations by Kevin Chadwick

Colorado has the highest average altitude—about 6,800 feet (2,100 meters) above sea level—of any state in the United States.

The first community chest, a single fund drive to support a number of charitable causes, was established in Denver. It was organized by four clergymen—a priest, a rabbi, and two ministers—in 1887. They named it the Charity Organization Society.

The largest silver nugget ever found in North America, *right,* was discovered in Aspen in 1894. The nugget weighed 1,840 pounds (835 kilograms) and was 93 percent pure silver. It was the largest silver nugget of such purity ever found in the world.



Largest nugget

Colorado had three governors in one day. Alva Adams had been governor for two months when charges of election fraud forced him out of office on March 17, 1905. The state legislature named James H. Peabody governor. He resigned the same day. Jesse F. McDonald, Adams' s lieutenant governor, took office.



Great Sand Dunes

Great Sand Dunes National Monument and Preserve has been called one of the country's strangest natural wonders. This huge area of sand, lying at the base of the Sangre de Cristo Mountains in south-central Colorado, is constantly shifting. It sometimes forms dunes as high as 700 feet (210 meters).



Denver & Colorado Convention & Visitors Bureau

Denver, Colorado's capital and largest city, boasts a spectacular view of the Rocky Mountains, which lie just west of the city.

ores. Today, however, the state's chief mineral products include coal, natural gas, and petroleum.

The U.S. government owns more than a third of Colorado's land. The government controls grazing, logging, and mining on those lands. The U.S. Mint in Denver makes coins. The U.S. Air Force has its academy close to Colorado Springs and its defense headquarters in nearby Cheyenne Mountain.

Spanish explorers who came in the 1600's were the first Europeans to visit the Colorado region. The Spanish word *colorado* means *colored red.* The explorers gave the name to the Colorado River, which flows through canyons of red stone. The state was named for the river.

Colorado's nickname is the *Centennial State.* The state has that name because it joined the Union in 1876, the *centennial* (100th anniversary) of the Declaration of Independence. Denver is the capital and largest city of Colorado.



© Nicholas Devore III, Photographers/Aspen

Raising beef cattle is an important agricultural activity in Colorado. Herds of cattle graze on the state's plains and mountains. Cattle are also fattened in feed lots.

Colorado in brief

Symbols of Colorado

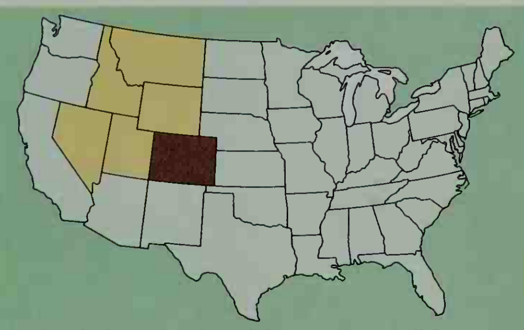
On the state flag, adopted in 1911, the red *C* stands for *Colorado,* which is Spanish for *colored red.* The golden ball represents the state's abundant sunshine and its gold production, and the blue and white bars symbolize blue skies and white mountain snows. On the seal, adopted in 1877, the triangular figure represents the "all-seeing" eye of God. The mountains stand for Colorado's rugged land, and the pick and hammer for the importance of mining.



State flag



State seal



Colorado (brown) ranks eighth in size among all the states and third in size among the Rocky Mountain States (yellow).

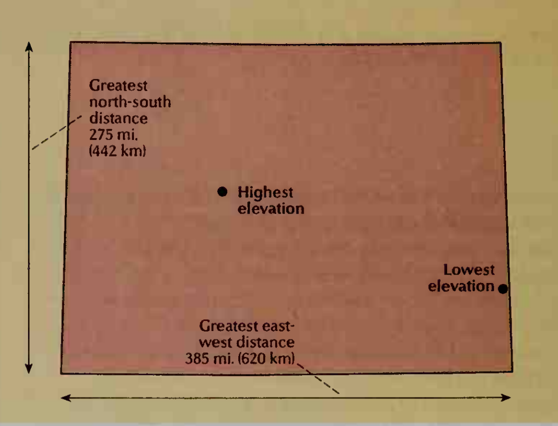
General information

Statehood: Aug. 1, 1876, the 38th state.
State abbreviations: Colo. (traditional); CO (postal).
State motto: *Nil sine Numine* (Nothing Without Providence).
State song: "Where the Columbines Grow." Words and music by A. J. Fynn.

The State Capitol is in Denver, Colorado's capital since 1876. Territorial capitals were Colorado City (1862), Golden (1862-1867), and Denver (1867-1876).

Land and climate

Area: 104,100 mi^2 (269,618 km^2), including 371 mi^2 (960 km^2) of inland water.
Elevation: *Highest*—Mount Elbert, 14,433 ft (4,399 m) above sea level. *Lowest*—3,350 ft (1,021 m) above sea level along the Arkansas River in Prowers County.
Record high temperature: 118 °F (48 °C), at Bennett on July 11, 1888.
Record low temperature: −61°F (−52 °C), at Maybell in Moffat County on Feb. 1, 1985.
Average July temperature: 74 °F (23 °C).
Average January temperature: 28° F (−2 °C).
Average yearly precipitation: 15 in (38 cm).



Important dates

- **1803** The United States acquired eastern Colorado in the Louisiana Purchase.
- **1806** Zebulon M. Pike explored Colorado.
- **1848** The United States took western Colorado after the Mexican War.
- **1859** The Colorado gold rush attracted thousands of prospectors and settlers.
- **1876** Colorado became the 38th state on August 1.



State bird
Lark bunting



State flower
White and lavender columbine



State tree
Colorado blue spruce

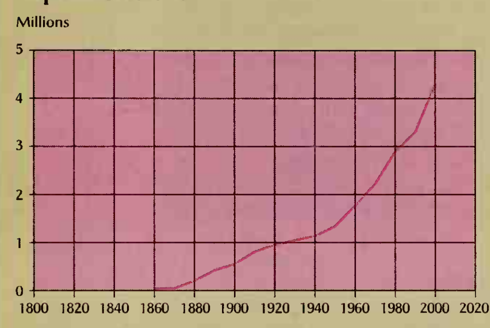
People

Population: 4,301,261 (2000 census)
Rank among the states: 24th
Population density: 41 per mi² (16 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 82 percent urban, 18 percent rural
Largest cities in Colorado

Denver	554,636
Colorado Springs	360,890
Aurora	276,393
Lakewood	144,126
Fort Collins	118,652
Arvada	102,153

Source: 2000 census, except for *, where figures are for 1990.

Population trend



Year	Population
2000	4,301,261
1990	3,307,912
1980	2,889,735
1970	2,209,596
1960	1,753,947
1950	1,325,089
1940	1,123,296
1930	1,035,791
1920	939,629
1910	799,024
1900	539,700
1890	413,249
1880	194,327
1870	39,864
1860	34,277

Source: U.S. Census Bureau.

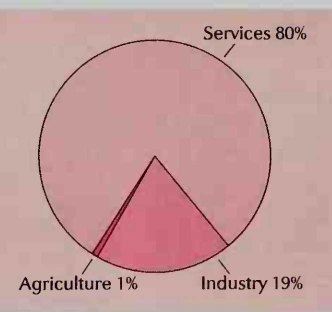
Economy

Chief products

Agriculture: beef cattle, wheat, corn, milk, hay.
Manufacturing: computer and electronic products, food products, chemicals, fabricated metal products, transportation equipment.
Mining: petroleum, coal, natural gas.

Gross state product

Value of goods and services produced in 1998: $141,791,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.



Source: U.S. Bureau of Economic Analysis.

Government

State government

Governor: 4-year term
State senators: 35; 4-year terms
State representatives: 65; 2-year terms
Counties: 63

Federal government

United States senators: 2
United States representatives*: 6 (7)
Electoral votes*: 8 (9)

*Figures in parentheses are for January 2003 and beyond.

Sources of information

For information about tourism, write to: Colorado Tourism Office: 1625 Broadway, Suite 1700, Denver, CO 80202. The Web site at www.colorado.com also provides information.
For information on the economy, write to: Office of Economic Development, 1625 Broadway, Suite 1710, Denver, CO 80202.
The state's official Web site at www.state.co.us also provides a gateway to much information on Colorado's economy, government, and history.

1906 The U.S. Mint in Denver issued its first coins; Mesa Verde National Park was established.

1915 Rocky Mountain National Park was established.

1958 The U.S. Air Force Academy's permanent campus opened near Colorado Springs.

1985 The Frying Pan-Arkansas Project was completed. It transfers water across Colorado.

1999 Black Canyon of the Gunnison became a national park.

People

Population. The 2000 United States census reported that Colorado had 4,301,261 people. The population had increased 31 percent over the 1990 census figure, 3,294,394. According to the 2000 census, Colorado ranks 24th in population among the 50 states.

More than four of every five Coloradans live in one of the state's seven metropolitan areas—Denver, Colorado Springs, Boulder-Longmont, Fort Collins-Loveland, Grand Junction, Greeley, and Pueblo (see **Metropolitan area**).

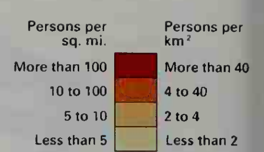
The state has eight cities with populations over 100,000. They are, in order of size, Denver, Colorado Springs, Aurora, Lakewood, Fort Collins, Arvada, Pueblo, and Westminster.

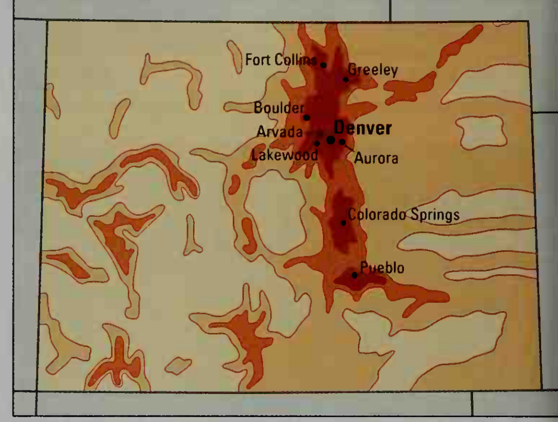
Most of Colorado's cities grew up near the eastern edge of the mountains. Denver, the largest city in the state, is a business, financial, and manufacturing center. Colorado Springs attracts large numbers of tourists. Colorado Springs also serves several military bases, including the United States Air Force Academy. The largest city in western Colorado is Grand Junction.

Schools. O. J. Goldrick opened the first school in Colorado in 1859. The students at the school were the chil-

Population density

About 85 percent of Colorado's people live in metropolitan areas. About half of the people live in or near Denver, the state's largest city and capital.





WORLD BOOK map; based on U.S. Census Bureau data.

Colorado map index

Metropolitan areas

Boulder-Longmont ... 291,288
Colorado Springs ... 516,929
Denver ... 2,109,282
Fort Collins-Loveland ... 251,494
Grand Junction ... 116,255
Greeley ... 180,936
Pueblo ... 141,472

Counties

Adams ... 363,857 .. D 13
Alamosa ... 14,966 .. I 10
Arapahoe ... 487,967 .. E 12
Archuleta ... 9,898 .. J 8
Baca ... 4,517 .. I 15
Bent ... 5,998 .. H 15
Boulder ... 291,288 .. D 11
Broomfield ... † .. D 11
Chaffee ... 16,242 .. G 9
Cheyenne ... 2,231 .. F 15
Clear Creek ... 9,322 .. E 10
Conejos ... 8,400 .. J 9
Costilla ... 3,663 .. I 11
Crowley ... 5,518 .. G 13
Custer ... 3,503 .. H 11
Delta ... 27,834 .. F 7
Denver ... 554,636 .. D 11
Dolores ... 1,844 .. I 6
Douglas ... 175,766 .. E 11
Eagle ... 41,659 .. D 9
Elbert ... 19,872 .. E 13
El Paso ... 516,929 .. F 12
Fremont ... 46,145 .. G 11
Garfield ... 43,791 .. E 6
Gilpin ... 4,757 .. D 10
Grand ... 12,442 .. D 9
Gunnison ... 13,956 .. F 8
Hinsdale ... 790 .. H 8
Huerfano ... 7,862 .. I 11
Jackson ... 1,577 .. C 9
Jefferson ... 527,056 .. E 11
Kiowa ... 1,622 .. G 15
Kit Carson ... 8,011 .. E 15
Lake ... 7,812 .. F 9
La Plata ... 43,941 .. I 7
Larimer ... 251,44 .. C 10
Las Animas ... 15,207 .. I 13
Lincoln ... 6,087 .. F 14
Logan ... 20,504 .. B 15
Mesa ... 116,255 .. F 5
Mineral ... 831 .. I 8
Moffat ... 13,184 .. C 6
Montezuma ... 23,830 .. I 5
Montrose ... 33,432 .. G 6
Morgan ... 27,171 .. D 13
Otero ... 20,311 .. H 13
Ouray ... 3,742 .. H 7
Park ... 14,523 .. F 10
Phillips ... 4,480 .. C 16
Pitkin ... 14,872 .. F 8
Prowers ... 14,483 .. H 16
Pueblo ... 141,472 .. H 12
Rio Blanco ... 5,986 .. D 6
Rio Grande ... 12,413 .. I 9
Routt ... 19,690 .. C 8
Saguache ... 5,917 .. H 9
San Juan ... 558 .. I 7
San Miguel ... 6,594 .. H 5
Sedgwick ... 2,747 .. B 15
Summit ... 23,548 .. D 9
Teller ... 20,555 .. F 11
Washington ... 4,926 .. D 14
Weld ... 180,936 .. C 12
Yuma ... 9,841 .. D 15

Cities, towns, and other populated places

Agate ... E 13
Aguilar ... 593 .. I 12
Air Force Academy see United States Air Force Academy
Akron° ... 1,711 .. D 14
Alamosa° ... 7,960 .. I 10
Alamosa East*‡ ... 1,528 .. I 10
Allenspark‡ ... 496 .. E 1
Allison ... J 7
Alma ... 179 .. E 10
Anton ... D 14
Antonito ... 873 .. J 10
Applewood*‡ ... 7,123 .. D 11
Arapahoe ... F 16
Arboles‡ ... 232 .. J 7
Arriba ... 244 .. E 14
Arvada ... 102,153 .. G 3
Aspen° ... 5,914 .. F 8
Aspen Park‡ ... 874 .. H 2
Ault ... 1,432 .. D 4
Aurora ... 276,393 .. G 3
Austin ... F 7
Avon ... 5,561 .. E 9
Avondale‡ ... 754 .. H 13
Barr Lake ... F 4
Basalt ... 2,681 .. E 8
Battlement Mesa‡ ... 3,497 .. E 6
Baxterville ... I 9
Bayfield ... 1,549 .. J 7
Bellvue ... D 2
Bennett ... 2,021 .. D 12
Berkley*‡ ... 10,743 .. G 3
Berthoud ... 4,839 .. E 3
Bethune ... 225 .. E 16
Beulah ... H 11
Black Forest‡ ... 13,247 .. J 4
Black Hawk ... 118 .. G 1
Blanca ... 391 .. I 10
Blue Mountain ... C 5
Blue River ... 685 .. E 10
Bonanza ... 14 .. G 9
Boncarbo ... J 12
Bond ... D 9
Boone ... 323 .. H 13
Boulder° ... 94,673 .. D 11
Bow Mar* ... 847 .. E 11
Bowie ... F 7
Boyero ... F 14
Brandon ... G 16
Branson ... 77 .. J 13
Breckenridge° ... 2,408 .. E 10
Breen ... J 6
Briggsdale ... B 12
Brighton° ... 20,905 .. F 4
Bristol ... H 16
Brookside ... 219 .. G 11
Brookvale ... H 1
Broomfield†° ... 38,272 .. G 2
Brush ... 5,117 .. C 14
Buckingham ... C 13
Buena Vista ... 2,195 .. F 9
Buffalo Creek ... I 2
Buford ... D 7
Burlington° ... 3,678 .. E 16
Byers‡ ... 1,233 .. D 13
Caddoa ... H 15
Cahone ... I 5
Calhan ... 896 .. F 13
Cameo ... F 6
Camp Bird ... H 7
Campion‡ ... 1,832 .. E 3
Campo ... 150 .. J 15
Canfield ... F 2
Canon City° ... 15,431 .. G 11
Capulin ... J 9
Carbondale ... 5,196 .. E 8
Cardiff ... E 8
Cascade ... K 3
Cascade-Chipita Park*‡ ... 1,709 .. J 3
Castle Rock° ... 20,224 .. I 3
Castlewood*‡ ... 25,567 .. E 12
Cedaredge ... 1,854 .. F 7
Cedarwood ... H 12
Center ... 2,392 .. I 10
Central City° ... 515 .. G 1
Chama ... J 11
Cheraw ... 211 .. H 14
Cherry Hills Village ... 5,958 .. H 3
Cheyenne Wells° ... 1,010 .. F 16
Chimney Rock ... J 8
Chipita Park ... K 3
Chivington ... G 15
Cimarron ... G 7
Cimarron Hills*‡ ... 15,194 .. F 12
Clifton‡ ... 17,345 .. F 6
Climax ... E 9
Coal Creek ... 303 .. G 11
Coaldale ... G 10
Coalmont ... C 9
Cokedale ... 139 .. J 12
Collbran ... 388 .. F 7
Colona ... G 7
Colorado City‡ ... 2,018 .. H 12
Colorado Springs° ... 360,890 .. F 12
Columbine ... B 8
Columbine*‡ ... 24,095 .. H 3
Columbine Valley ... 1,132 .. H 3
Commerce City ... 20,991 .. G 3
Como ... E 10
Conejos° ... J 10
Conifer ... H 2
Cope ... E 15
Cortez° ... 7,977 .. I 5
Cotopaxi ... G 10
Craig° ... 9,189 .. C 7
Crawford ... 366 .. G 7
Creede° ... 377 .. H 8
Crested Butte ... 1,529 .. F 8
Crestone ... 73 .. H 10
Cripple Creek° ... 1,115 .. F 11
Crook ... 128 .. B 15
Crowley ... 187 .. H 13
Cuchara ... I 11
Dacono ... 3,015 .. F 3
Dailey ... B 15
De Beque ... 451 .. E 6
Deckers ... I 2
Deer Trail ... 598 .. E 13
Delhi ... I 13
Del Norte° ... 1,705 .. I 9
Delta° ... 6,400 .. G 6
Denver° ... 554,636 .. D 11
Derby*‡ ... 6,423 .. G 3
Dillon ... 802 .. E 10
Dinosaur ... 319 .. C 5
Divide ... K 2
Dolores ... 857 .. I 6
Dove Creek° ... 698 .. H 5
Doyleville ... G 9
Drake ... D 2
Dupont ... G 3
Durango° ... 13,922 .. J 7
Eads° ... 747 .. G 15
Eagle° ... 3,032 .. E 8
Eagle-Vail*‡ ... 2,887 .. E 9
East Portal ... G 1
Eaton ... 2,690 .. D 4
Echo Lake ... H 1
Eckley ... 278 .. D 15
Edgewater ... 5,445 .. G 3
Edler ... J 15
Edwards‡ ... 8,257 .. E 9
Egnar ... H 5
Elbert ... F 12
Eldora‡ ... 170 .. F 1
Eldorado Springs‡ ... 557 .. F 2
El Jebel‡ ... 4,488 .. E 8
Elizabeth ... 1,434 .. I 4
Elk Springs ... C 6
Ellicott ... F 12
Empire ... 355 .. G 1
Englewood ... 31,727 .. H 3
Erie ... 6,291 .. F 3
Estes Park ... 5,413 .. E 1
Estrella ... I 10
Evans ... 9,514 .. E 4
Evergreen‡ ... 9,216 .. H 2
Fairplay° ... 610 .. E 10
Falcon ... F 12
Farisita ... I 11
Federal Heights* ... 12,065 .. G 3
Firestone ... 1,908 .. F 3
Flagler ... 612 .. E 15
Fleming ... 426 .. B 15
Florence ... 3,653 .. G 11
Florissant ... K 2
Fort Carson*‡ ... 10,566 .. G 12
Fort Collins° ... 118,652 .. C 11
Fort Garland‡ ... 432 .. I 11
Fort Lupton ... 6,787 .. F 4
Fort Lyon ... H 14
Fort Morgan° ... 11,034 .. C 13
Fountain ... 15,197 .. G 12
Fowler ... 1,206 .. H 13
Franktown‡ ... 99 .. I 4
Fraser ... 910 .. D 10
Frederick ... 2,467 .. F 3
Frisco ... 2,443 .. E 10
Fruita ... 6,478 .. F 5
Fruitvale‡ ... 6,936 .. F 6
Galeton ... D 4
Garcia ... J 11
Garden City ... 357 .. E 4
Gardner ... H 11
Garfield ... G 9
Gateway ... G 5
Gato ... J 8
Gem Village ... J 7
Genesee*‡ ... 3,699 .. G 2
Genoa ... 211 .. E 14
Georgetown° ... 1,088 .. G 1
Gilcrest ... 1,162 .. E 4
Gilman ... E 9
Glade Park ... F 5
Glen Haven ... D 1
Glendale* ... 4,547 .. D 11
Glendevey ... B 10
Gleneagle*‡ ... 4,246 .. J 3
Glenisle ... I 1
Glenwood Springs° ... 7,736 .. E 7
Golden° ... 17,159 .. G 2
Goodrich ... C 13
Gould ... C 10
Granada ... 640 .. H 16
Granby ... 1,525 .. D 10
Grand Junction° ... 41,986 .. F 5
Grand Lake ... 447 .. C 10
Granite ... F 9
Grant ... H 1
Greeley° ... 76,930 .. C 12
Green Mountain Falls ... 773 .. K 3
Greenwood Village ... 11,035 .. H 3
Greystone ... C 5
Grover ... 153 .. B 12
Guffey ... K 1
Gunbarrel*‡ ... 9,435 .. E 11
Gunnison° ... 5,409 .. G 8
Gypsum ... 3,654 .. E 8
Hamilton ... C 7
Hartman ... 111 .. H 16
Hartsel ... F 10
Hasty ... H 15
Haswell ... 84 .. G 14
Haxtun ... 982 .. C 15
Hayden ... 1,634 .. C 8
Heeney ... D 9
Henderson ... G 3
Hesperus ... J 6
Highlands Ranch*‡ ... 70,931 .. H 3
Hillrose ... 254 .. C 14
Hoehne ... J 12
Holly ... 1,048 .. H 16
Holyoke° ... 2,261 .. C 16
Hooper ... 123 .. I 10
Hot Sulphur Springs° ... 521 .. D 10
Hotchkiss ... 968 .. F 7

dren of gold miners in the Cherry Creek area (now Denver).

Today, a seven-member State Board of Education heads the state Department of Education. Board members are elected to six-year terms. They appoint a commissioner of education to direct the department. Elected school boards and appointed superintendents run the local districts.

Children must attend school from age 7 through 15. For the number of students and teachers in Colorado, see **Education** (table).

Libraries. Colorado's first public library was established in Denver in 1860. Today, Colorado has approximately 230 public libraries. Of these, about 30 are county libraries. The Colorado State Library is located in Denver.

Museums. The Denver Art Museum features an Indian and native arts collection. The Denver Museum of Natural History has displays about animals. The Dinosaur Valley Museum in Grand Junction displays dinosaur fossils. The State Historical Society operates museums in Denver, Fort Garland, Georgetown, Leadville, Montrose, Platteville, Pueblo, and Trinidad.

Universities and colleges

This table lists the universities and colleges in Colorado that grant bachelor's or advanced degrees and are accredited by the North Central Association of Colleges and Schools.

Name	Mailing address
Adams State College	Alamosa
Colorado, University of	*
Colorado Christian University	Lakewood
Colorado College	Colorado Springs
Colorado School of Mines	Golden
Colorado State University	Fort Collins
Colorado Technical University	Colorado Springs
Denver, University of	Denver
Denver Seminary	Denver
DeVry Institute of Technology	†
Financial Planning, College for	Greenwood Village
Fort Lewis College	Durango
Iliff School of Theology	Denver
Jones International University	Englewood
Mesa State College	Grand Junction
Metropolitan State College of Denver	Denver
Naropa University	Boulder
National Technological University	Fort Collins
National Theatre Conservatory	Denver
Northern Colorado, University of	Greeley
Regis University	Denver
Rocky Mountain College of Art and Design	Denver
Southern Colorado, University of	Pueblo
United States Air Force Academy	U.S.A.F. Academy
Western State College	Gunnison

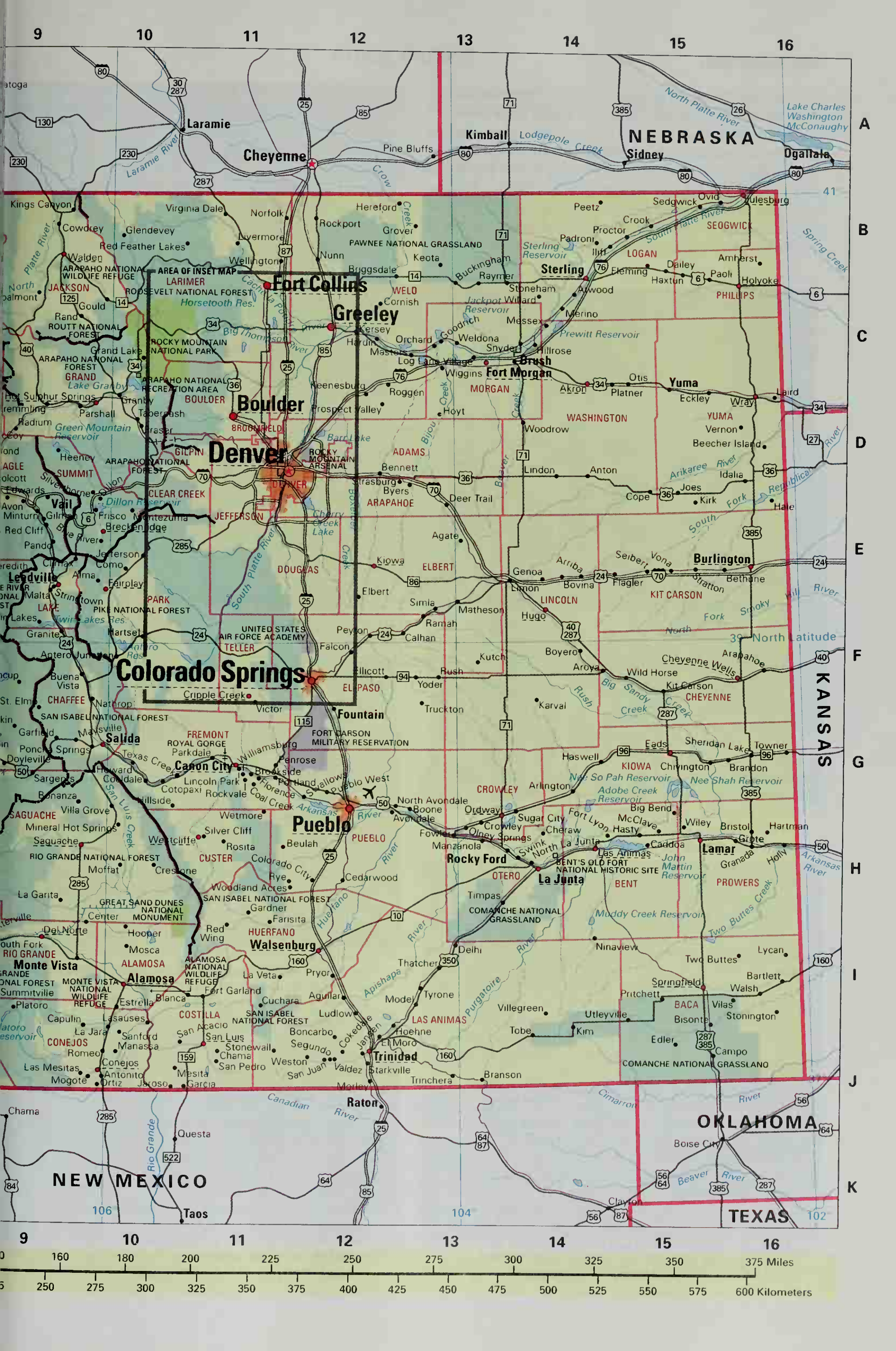
*For campuses, see Colorado, University of.
†Campuses at Colorado Springs, Denver, and Greenwood Village.

Place	Population	Map key
Howard		G 10
Hoyt		D 13
Hudson	918	F 4
Hugo°	660	F 14
Hygiene		E 2
Idaho Springs	1,834	G 1
Idalia		D 16
Ignacio	720	J 7
Hudson	1,565	F 4
Hugo°	885	F 14
Hygiene		E 2
Idaho Springs	1,889	G 1
Idalia		D 16
Ignacio	669	J 7
Iliff	213	B 14
Jamestown	205	F 1
Jansen		J 12
Jaroso		J 10
Jefferson		E 10
Joes		D 15
Johnstown	3,827	E 3
Juanita		J 8
Julesburg°	1,467	B 16
Karval		G 14
Kassler		H 2
Keenesburg	855	D 12
Ken Caryl*‡	30,887	E 11
Keota		B 13
Kersey	1,389	C 12
Kim	65	J 14
Kings Canyon		B 9
Kiowa°	581	E 12
Kirk		E 15
Kit Carson	253	F 15
Kittredge‡	954	H 2
Kremmling	1,578	D 9
Kutch		F 13
Lalayette	23,197	F 3
La Garita		H 9
Laird		D 16
La Jara	877	J 10
La Junta°	7,568	H 14
Lake City°	375	H 8
Lake George		J 2
Lakeside	20	G 2
Lakewood	144,126	G 3
Lamar°	8,869	H 15
Laporte‡	2,691	D 2
Larkspur	234	I 3
La Salle	1,849	E 4
Las Animas°	2,758	H 14
Lasauses		J 10
Las Mesitas		J 10
La Veta	924	I 11
Lawson		G 1
Leadville°	2,821	E 9
Leadville North*‡	1,942	F 9
Liberty Bell Village		H 7
Limon	2,071	E 14
Lincoln Park‡	3,904	G 11
Lindon		D 14
Littleton°	40,340	H 3
Livermore		B 11
Lochbuie	2,049	F 4
Log Lane Village	1,006	C 13
Loma		E 5
Longmont	71,093	F 2
Longview		I 2
Louisville	18,937	F 3
Louviers‡	237	H 3
Loveland	50,608	D 3
Lucerne		D 4
Ludlow		I 12
Lycan		I 16
Lyons	1,585	E 2
Mack		E 5
Maher		G 7
Manassa	1,042	J 10
Mancos	1,119	I 6
Manitou Springs	4,980	K 3
Manzanola	525	H 13
Marble	105	F 8
Masonville		D 2
Matheson		F 13
Maysville		G 10
McClave		H 15
McCoy		D 9
Mead	2,017	E 3
Meeker°	2,242	D 7
Meeker Park		E 1
Meredith		E 9
Merino	246	C 14
Mesa		F 6
Mesita		J 10
Messex		C 14
Milliken	2,888	E 3
Milner		C 8
Minturn	1,068	E 9
Model		I 13
Moffat	114	H 10
Mogote		J 10
Molina		F 6
Monte Vista	4,529	I 9
Montezuma	42	E 10
Montrose°	12,344	G 7
Monument	1,971	J 3
Morrison*	430	E 11
Mosca		I 10
Mount Crested Butte	707	F 8
Mountain View	569	G 3
Nathrop		G 10
Naturita	635	H 6
Nederland	1,394	F 1
New Castle	1,984	E 7
Ninaview		I 14
Niwot‡	4,160	F 2
Norfolk		B 11
North Avondale		G 12
North La Junta		H 14
Northglenn	31,575	F 3
Norwood	438	H 6
Nucla	734	G 6
Nunn	471	B 12
Oak Creek	849	C 8
Ohio		G 9
Olathe	1,573	G 6
Oliver		F 7
Olney Springs	389	H 13
Ophir	113	H 7
Orchard		C 13
Orchard City	2,880	F 6
Orchard Mesa‡	6,456	F 6
Ordway°	1,248	H 13
Ortiz		J 10
Otis	534	C 15
Ouray°	813	H 7
Ovid	330	B 15
Padroni‡	97	B 14
Pagosa Springs°	1,591	J 8
Palisade	2,579	F 6
Palmer Lake	2,179	J 3
Pando		E 9
Pandora		H 7
Paoli	42	B 15
Paonia	1,497	F 7
Parachute	1,006	E 6
Paradox		G 5
Parker	23,558	H 4
Parlin		G 9
Parshall		D 9
Peetz	227	B 14
Penrose‡	4,070	G 11
Peyton		F 12
Phippsburg		C 8
Pierce	884	D 4
Pine		I 2
Pinecliffe		F 1
Pinery, The*‡	7,253	H 4
Pitkin	124	G 9
Placerville		H 6
Plateau City		E 6
Platner		D 14
Platoro		I 9
Platteville	2,370	E 4
Pleasant View		I 5
Poncha Springs	466	G 10
Ponderosa Park*‡	3,112	I 4
Powder Wash		B 6
Powderhorn		H 8
Pritchett	137	I 15
Proctor		B 14
Pueblo°	102,121	H 12
Pueblo West‡	16,899	G 12
Radium		D 9
Ramah	117	F 13
Rand		C 9
Range		D 8
Rangely	2,096	D 5
Raymer	91	C 13
Red Cliff	289	E 9
Red Feather Lakes		B 10
Redlands*‡	8,043	F 5
Redstone		E 8
Redvale		H 6
Ricu	205	I 6
Ridgway	713	H 7
Rille	6,784	E 7
Rio Blanco		D 6
Rockport		B 12
Rockvale	426	G 11
Rocky Ford	4,286	H 13
Rollinsville		G 1
Romeo	375	J 10
Rush		F 13
Rye	202	H 11
Saguache°	578	H 9
Salida°	5,504	G 10
San Acacio		J 11
San Juan		J 12
San Luis°	739	J 11
San Pedro		J 11
Sanford	817	J 10
Sargents		G 9
Sawpit	25	H 7
Security-Widefield‡	29,845	K 4
Sedalia‡	211	H 3
Sedgwick	191	B 15
Segundo		J 12
Seibert	180	E 15
Severance	597	D 3
Shamballah Ashrama		I 3
Shawnee		I 1
Sheridan	5,600	H 3
Sheridan Lake	66	G 16
Sherrel-wood*‡	17,657	D 12
Silt	1,740	E 7
Silver Cliff	512	H 11
Silver Plume	203	G 1
Silver Springs		H 2
Silverthorne	3,196	E 10
Silverton°	531	H 7
Simla	663	F 13
Slater		B 7
Slick Rock		H 5
Snowmass		E 8
Snowmass Village	1,822	F 8
Snyder		C 13
Somerset		F 7
South Fork		I 9
Southern Ute Indian Reservation	11,159	J 7
Southglenn*‡	43,520	D 12
Springfield°	1,562	I 15
Starkville	128	J 12
Steamboat Springs°	9,815	C 8
Sterling°	11,360	B 14
Stoneham		C 13
Stonewall		J 11
Strasburg‡	1,402	D 12
Stratmoor*‡	6,650	F 12
Stratton	669	E 15
Stringtown		F 9
Sugar City	279	H 14
Summitville		I 9
Superior	9,011	F 2
Swink	696	H 14
Tahernash‡	165	D 10
Taryall		J 1
Telluride°	2,221	H 7
Texas Creek		G 10
Thatcher		I 13
Thornton	82,384	G 3
Tiffany		J 7
Timnath	223	D 3
Timpas		H 13
Tole		J 14
Toponas		D 8
Towaoc‡	1,097	J 5
Trinchera		J 13
Trinidad°	9,078	J 12
Truckton		G 13
Twin Lakes		F 9
Two Buttes	67	I 16
Tyrone		I 13
United States Air Force Academy‡	7,526	J 3
Uravan		G 5
Ute Mountain Indian Reservation	1,410	J 5
Utleyville		I 15
Vail	4,531	E 9
Vallecito		I 7
Vancorum		H 5
Vernon		D 16
Victor	445	G 11
Vilas	110	I 16
Villa Grove		H 10
Villegreen		I 14
Virginia Dale		B 11
Vona	95	E 15
Walden°	734	B 9
Walsenburg°	4,182	I 12
Walsh	723	I 16
Ward	169	F 1
Wattenberg		F 3
Welby*‡	12,973	D 12
Weldona		C 13
Wellington	2,672	B 11
Westcliffe°	417	H 11
Westminster	100,940	G 3
Weston		J 12
Wetmore		H 11
Wheat Ridge	32,913	G 2
Whitewater		F 6
Widefield, see Security-Widefield		
Wiggins	838	C 13
Wild Horse		F 15
Wiley	483	H 15
Williamsburg	714	G 11
Windsor	9,896	D 3
Winter Park	662	G 1
Wolcott		D 9
Wondervu		F 2
Woodland Acres		H 12
Woodland Park	6,515	J 3
Woodmoor*‡	7,177	F 12
Woodrow		D 14
Woody Creek		E 8
Wray°	2,187	D 16
Yampa	443	D 8
Yellow Jacket		I 5
Yoder		F 13
Yuma	3,285	D 15

*Does not appear on map; key shows general location.
†Broomfield County was created in 2001 out of parts of Adams, Boulder, Jefferson, and Weld counties. Broomfield became its county seat.
°County seat.
‡Census designated place—unincorporated, but recognized as a significant settled community by the U.S. Census Bureau.
Places without population figures are unincorporated areas.
Source: 2000 census.



Colorado political map
Urban area
Park or other recreation area
Forest or other conservation area
Military or other federal area
Indian reservation
State boundary
County boundary
BACA County name
State capital
County seat
City or town
Park or other recreation area
Point of interest
Major airport
Waterway
Railroad
Highways:
Expressway
Other road
Interstate
U.S.
Other
Lambert conformal conic projection
WORLD BOOK map
ROOSEVELT NATIONAL FOREST
Fort Collins
Loveland
Greeley
Longmont
Boulder
Westminster
Arvada
Wheat Ridge
Golden
Lakewood
Denver
Aurora
Thornton
Northglenn
Broomfield
Englewood
Littleton
Castle Rock
Colorado Springs
Manitou Springs
Cripple Creek
Security-Widefield
LARIMER
BOULDER
WELD
ADAMS
ARAPAHOE
JEFFERSON
DOUGLAS
TELLER
EL PASO
PARK
GRAND
GILPIN
CLEAR CREEK
ROCKY MOUNTAIN NATIONAL PARK
ARAPAHO NATIONAL FOREST
PIKE NATIONAL FOREST
DENVER INTERNATIONAL AIRPORT
UNITED STATES AIR FORCE ACADEMY
GARDEN OF THE GODS
FLORISSANT FOSSIL BEDS NATIONAL MONUMENT
PIKES PEAK
PETERSON FIELD
Inset map scale
50 Miles
80 Kilometers
Rock Springs
WYOMING
UTAH
ARIZONA
MOFFAT
ROUTT
RIO BLANCO
GARFIELD
MESA
DELTA
PITKIN
GUNNISON
MONTROSE
OURAY
SAN MIGUEL
DOLORES
SAN JUAN
HINSDALE
MINERAL
MONTEZUMA
LA PLATA
ARCHULETA
Craig
Steamboat Springs
Meeker
Rifle
Glenwood Springs
Carbondale
Aspen
Grand Junction
Clifton
Delta
Montrose
Gunnison
Cortez
Durango
DINOSAUR NATIONAL MONUMENT
BROWNS PARK NATIONAL WILDLIFE REFUGEE
ROUTT NATIONAL FOREST
WHITE RIVER NATIONAL FOREST
GRAND MESA NATIONAL FOREST
GUNNISON NATIONAL FOREST
COLORADO NATIONAL MONUMENT
MANTI-LA SAL NATIONAL FOREST
BLACK CANYON OF THE GUNNISON NATIONAL PARK
CURECANTI NATIONAL RECREATION AREA
UNCOMPAHGRE NATIONAL FOREST
SAN JUAN NATIONAL FOREST
RIO GRANDE NATIONAL FOREST
MESA VERDE NATIONAL PARK
UTE MOUNTAIN INDIAN RESERVATION
SOUTHERN UTE INDIAN RESERVATION
HOVENWEEP NATIONAL MONUMENT
YUCCA HOUSE NATIONAL MONUMENT
NARROW GAUGE RAILROAD
ONLY POINT IN THE UNITED STATES COMMON TO FOUR STATE CORNERS
Shiprock
Farmington
Bloomfield
108 West Longitude
North
Main map scale



9
10
11
12
13
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15
16
A
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C
D
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G
H
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J
K
NEBRASKA
KANSAS
OKLAHOMA
NEW MEXICO
TEXAS
Laramie
Cheyenne
Pine Bluffs
Kimball
Lodgepole Creek
Sidney
Ogallala
North Platte River
Lake Charles Washington McConaughy
Crow Creek
Laramie River
Kings Canyon
Virginia Dale
Norfolk
Hereford
Rockport
Grover
PAWNEE NATIONAL GRASSLAND
Keota
Nunn
Livermore
Wellington
Briggsdale
Buckingham
Raymer
Stoneham
Peetz
Sedgwick
Ovid
Julesburg
Crook
Proctor
Padroni
Iliff
SEDGWICK
South Platte River
LOGAN
Sterling
Sterling Reservoir
Fleming
Haxtun
Dailey
Amherst
Paoli
Holyoke
PHILLIPS
Spring Creek
Atwood
Merino
Jackpot Willard Reservoir
Messex
Prewitt Reservoir
Hillrose
Brush
Fort Morgan
MORGAN
Snyder
Weldona
Goodrich
Orchard
Log Lane Village
Wiggins
Akron
Otis
Platner
Yuma
Eckley
Wray
Laird
YUMA
Vernon
Beecher Island
WASHINGTON
Woodrow
Hoyt
Cowdrey
Glendevey
Red Feather Lakes
Walden
ARAPAHO NATIONAL WILDLIFE REFUGE
JACKSON
North Platte River
Walden
Gould
Rand
ROUTT NATIONAL FOREST
AREA OF INSET MAP
LARIMER
ROOSEVELT NATIONAL FOREST
Horsetooth Res.
Fort Collins
WELD
Cornish
Greeley
Kersey
Hardin
Masters
Big Thompson River
ROCKY MOUNTAIN NATIONAL PARK
Grand Lake
ARAPAHO NATIONAL FOREST
GRAND
Lake Granby
Granby
ARAPAHO NATIONAL RECREATION AREA
BOULDER
Boulder
Keenesburg
Roggen
Prospect Valley
Hot Sulphur Springs
Kremmling
Parshall
Tabernash
Radium
Green Mountain Reservoir
Fraser
BROOMFIELD
GILPIN
Denver
DENVER
ROCKY MOUNTAIN ARSENAL
Barr Lake
ADAMS
Bijou Creek
Bennett
Strasburg
Byers
ARAPAHOE
Deer Trail
Lindon
Anton
Cope
Joes
Kirk
Idalia
Arikaree River
Republican River
Hale
Heeney
ARAPAHO NATIONAL FOREST
SUMMIT
EAGLE
Silverthorne
Dillon
Dillon Reservoir
Vail
Avon
Minturn
Gilman
Frisco
Montezuma
Breckenridge
Red Cliff
Pando
CLEAR CREEK
JEFFERSON
Cherry Creek Lake
Agate
Jefferson
Como
Alma
Fairplay
Leadville
Climax
LAKE
Twin Lakes Res.
Twin Lakes
Malta
Stringtown
Granite
PARK
PIKE NATIONAL FOREST
DOUGLAS
South Platte River
Kiowa
ELBERT
Elbert
Genoa
Limon
Arriba
Bovina
Flagler
Seibert
Vona
Burlington
Stratton
Bethune
KIT CARSON
LINCOLN
Hugo
Simla
Matheson
Ramah
Calhan
Peyton
Falcon
UNITED STATES AIR FORCE ACADEMY
TELLER
Hartsel
Antero Junction
Antero Res.
Buena Vista
CHAFFEE
Nathrop
St. Elmo
SAN ISABEL NATIONAL FOREST
Colorado Springs
Cripple Creek
Victor
Ellicott
EL PASO
Yoder
Rush
Truckton
Kutch
Boyero
Aroya
Karval
Big Sandy Creek
Wild Horse
Kit Carson
CHEYENNE
Cheyenne Wells
Arapahoe
39° North Latitude
Smoky Hill River
North Fork
Fountain
FORT CARSON MILITARY RESERVATION
FREMONT
ROYAL GORGE
Parkdale
Maysville
Salida
Poncha Springs
Garfield
Texas Creek
Canon City
Williamsburg
Penrose
Brookside
Portland
Florence
Coal Creek
Lincoln Park
Cotopaxi
Rockvale
Howard
Coaldale
Sargents
Bonanza
SAGUACHE
Villa Grove
Mineral Hot Springs
Saguache
Hillside
Wetmore
Silver Cliff
Westcliffe
Rosita
CUSTER
Beulah
Pueblo
Pueblo West
PUEBLO
Arkansas River
Boone
Avondale
North Avondale
Ordway
CROWLEY
Crowley
Olney Springs
Sugar City
Arlington
Haswell
Eads
Sheridan Lake
Towner
KIOWA
Chivington
Brandon
Nee So Pah Reservoir
Nee Shah Reservoir
Adobe Creek Reservoir
Big Bend
McClave
Hasty
Wiley
Bristol
Hartman
Granada
Holly
Lamar
Caddoa
Las Animas
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John Martin Reservoir
BENT
PROWERS
Cheraw
Swink
La Junta
North La Junta
Fort Lyon
Fowler
Manzanola
Rocky Ford
OTERO
Timpas
COMANCHE NATIONAL GRASSLAND
Muddy Creek Reservoir
Two Buttes Creek
Colorado City
Rye
Cedarwood
Woodland Acres
RIO GRANDE NATIONAL FOREST
Moffat
Crestone
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GREAT SAND DUNES NATIONAL MONUMENT
Center
Gardner
Farisita
Huerfano
Del Norte
Hooper
Mosca
Red Wing
HUERFANO
Walsenburg
RIO GRANDE
Monte Vista
ALAMOSA
Alamosa
ALAMOSA NATIONAL WILDLIFE REFUGE
MONTE VISTA NATIONAL WILDLIFE REFUGE
Summitville
La Veta
Pryor
Fort Garland
Blanca
Estrella
Platoro
Capulin
Lasauses
La Jara
Sanford
Manassa
Romeo
COSTILLA
San Acacio
San Luis
Cuchara
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Aguilar
Ludlow
Boncarbo
Segundo
Cokedale
Jansen
Stonewall
Chama
San Pedro
Weston
San Juan
Valdez
Trinidad
El Moro
Hoehne
Model
Tyrone
Thatcher
Delhi
LAS ANIMAS
Purgatoire River
Apishapa River
Villegreen
Tobe
Kim
Utleyville
Ninaview
Two Buttes
Lycan
Bartlett
Walsh
Springfield
Pritchett
BACA
Vilas
Stonington
Bisonte
Edler
Campo
COMANCHE NATIONAL GRASSLAND
CONEJOS
Conejos
Las Mesitas
Mogote
Antonito
Ortiz
Jaroso
Mesita
Garcia
Starkville
Trinchera
Branson
Morley
Raton
Canadian River
Cimarron River
Chama
Questa
Rio Grande
Taos
Boise City
Beaver River
Clayton
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14
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16
160
180
200
225
250
275
300
325
350
375 Miles
250
275
300
325
350
375
400
425
450
475
500
525
550
575
600 Kilometers

Visitor's guide

Beautiful Colorado attracts millions of tourists each year. In summer, visitors enjoy the state's cool climate. Campers pitch their tents on forested mountain slopes or near beautiful mountain streams. High peaks test the skill of mountain climbers. Old mining towns and Indian cliff dwellings lure tourists interested in history. People who like to fish cast for trout in the clear, swift streams. In autumn, hunters search for deer and other big game. In winter, skiers visit such famous Colorado resorts as Aspen, Arapahoe Basin, Steamboat Springs, Vail, and Winter Park. The ski season in Colorado begins in November and ends in April.

Many Colorado cities and towns hold fairs, festivals, races, and rodeos during the summer. In winter, the state hosts a variety of skiing and other winter sports events and competitions. In addition, many art, business, education, and religious groups hold conferences in Colorado.



James P. Rowan

Mesa Verde National Park, near Cortez

Places to visit

Following are brief descriptions of some of Colorado's many interesting places to visit:

Air Force Academy, north of Colorado Springs, trains the nation's air force officers. The Visitors Center, located at the south entrance, shows films about the academy.

Bent's Old Fort, east of La Junta, is a reconstructed trading post and a national historic site. The fort, which was originally built in 1833, was the first permanent American settlement in Colorado.

Buffalo Bill's Grave, on top of Lookout Mountain near Golden, honors the famous scout and showman William F. Cody (see **Buffalo Bill**).

Central City, once a rich gold camp, is now popular for its small stakes gambling clubs. A theater festival is held each summer in the opera house.

Cumbres & Toltec Scenic Railroad runs between Antonito and Osier and Osier and Chama, New Mexico. Steam-powered trains carry passengers through beautiful and historic areas, including the Toltec Gorge and the Los Pinos River Valley.

Garden of the Gods, near Colorado Springs, is a breathtaking cluster of huge red sandstone rocks. Thousands of worshipers gather there on Easter Sunday for sunrise services. See **Garden of the Gods.**

Museum of Western Art, in Denver, houses paintings and sculptures by a number of Western artists, including Frederic Remington, Charles M. Russell, and Thomas Moran.

Narrow-gauge railroad runs between Durango and Silverton. The tracks of the railroad are set closer together than modern ones. Summer visitors can take a 90-mile (140-kilometer) round trip through beautiful canyons.

Pikes Peak, west of Colorado Springs, is probably the most famous mountain in the Rockies, even though 30 Colorado peaks are higher. Visitors can reach the top of the mountain by automobile toll road, cog railway, on horseback, or on foot. For more information, see **Pikes Peak.**

Red Rocks Amphitheater, near Denver, is an open-air amphitheater that seats 9,000 people. It is surrounded by massive natural red rock formations that provide excellent acoustics. It hosts concerts and stage shows, as well as sunrise services on Easter Sunday.

Royal Gorge, near Canon City, is a massive canyon cut by the Arkansas River. The gorge, more than 1,000 feet (300 meters) deep, is crossed by the world's highest suspension bridge. See **Royal Gorge.**

United States Mint, in Denver, manufactures millions of coins each year. Tours of the mint are given. See **Mint.**

National parks, monuments, and forests. Colorado's national parks include Rocky Mountain, Mesa Verde, and Black Canyon of the Gunnison. Rocky Mountain National Park, in north-central Colorado, has more than 100 peaks that rise over 11,000 feet (3,350 meters). Mesa Verde National Park, near Cortez, preserves Indian cliff dwellings almost a thousand years old. Black Canyon of the Gunnison National Park offers spectacular views from the rims of a steep-walled canyon. See the separate articles in *World Book* on each national park.

Other areas of scenic beauty or historical interest include Great Sand Dunes National Monument and Preserve and the following national monuments: Colorado, Dinosaur, Florissant Fossil Beds, Hovenweep, and Curecanti National Recreation Area.

Twelve national forests cover about 13,774,000 acres (5,574,100 hectares) in Colorado. Completely within the state are Arapaho, Grand Mesa, Gunnison, Pike, Rio Grande, Roosevelt, Routt, San Isabel, San Juan, Uncompahgre, and White River national forests. Manti-La Sal forest lies partly in Utah.

Other parks. The city of Denver maintains many beautiful mountain parks that are outside its city limits. Since 1963, Colorado has created state parks on land administered by the state fish and game commission. For information, write to Colorado State Parks, 1313 Sherman, Denver, CO 80203.

National Park Service

Sky Pond in Rocky Mountain National Park



Aspen Skiing Company

World Cup skiing in Aspen

Annual events

January-June

National Western Stock Show in Denver (January); Breckenridge Ullrfest Winter Carnival (January); Steamboat Springs Winter Carnival (February); World Cup Ski Racing Competitions in Vail and Aspen (February and March); Winter Park Wingbreak (April); Iron Horse Bicycle Classic in Durango (May); Telluride Wine Festival (June); Telluride Bluegrass Festival (June); Frog Rodeo in Empire (June).

July-December

Denver Cherry Creek Arts Festival (July); Strings in the Mountains Chamber Music Festival in Steamboat Springs (July); Central City Opera Festival (July and August); Colorado Shakespeare Festival in Boulder (July and August); Festival of the Arts in Crested Butte (August); Colorado State Fair in Pueblo (August); Festival of Mountain and Plain in Denver (September); Rocky Mountain Colorfest, throughout southwestern Colorado (September and October); Larimer Square Oktoberfest in Denver (September); Parade of Lights in Denver (December).



U.S. Air Force

The U.S. Air Force Academy near Colorado Springs



Denver & Colorado Convention & Visitors Bureau

Narrow gauge railroad between Durango and Silverton

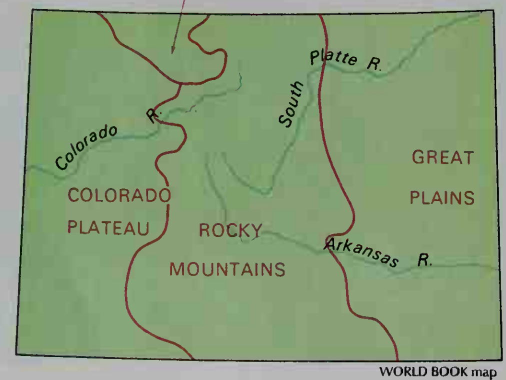
Land and climate

Land regions. Colorado has four main land regions: (1) the Colorado Plateau, (2) the Intermontane Basin, (3) the Rocky Mountains, and (4) the Great Plains.

The Colorado Plateau, along the western border, covers about a fifth of the state. It is an area of high hills, plateaus, deep valleys, and *mesas* (flat-topped hills with steep sides). Farmers raise a variety of crops in the valleys. During summer months, cattle and sheep graze on the grasslands of the mesas.

The Intermontane Basin, north of the plateau, is Colorado's smallest land region. It is a region of rolling hills and sagebrush plateaus wedged between mountain ranges near the northwest corner of the state. The word *intermontane* means *between mountains.* Herds of sheep graze on the plateaus, and forests cover the hills in this region.

The Rocky Mountains cover the middle two-fifths of Colorado. The Colorado Rockies have been called the *Roof of North America* because between 50 and 60 peaks reach 14,000 feet (4,270 meters) or more above sea level. These peaks are the tallest in the entire Rocky Mountain chain, which stretches from Alaska to New Mexico.



Land regions of Colorado

The Continental Divide runs through the Colorado Rockies. Streams east of the divide flow into the Atlantic Ocean. Those west of the divide flow into the Pacific. The Colorado Rockies are one of the country's most popular areas for mountain climbing, fishing, hunting, and skiing.

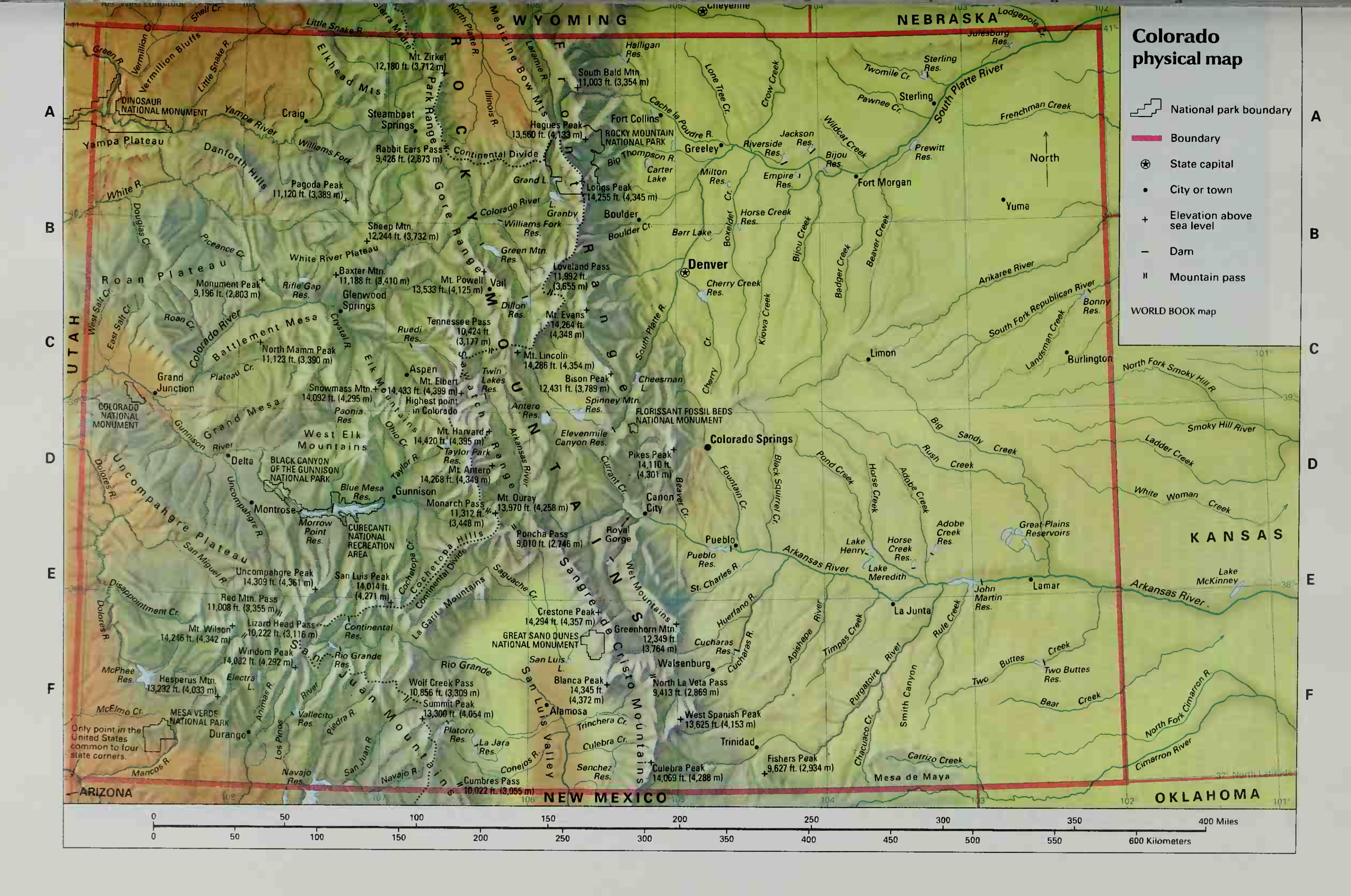
The Rocky Mountains of Colorado consist of five main mountain ranges: (1) the Front Range, (2) the Park Range, (3) the Sawatch Range, (4) the San Juan Mountains, and (5) the Sangre de Cristo Mountains. The easternmost group is the Front Range, which includes Mount Evans (14,264 feet, or 4,348 meters), Longs Peak (14,255 feet, or 4,345 meters), Pikes Peak (14,110 feet, or 4,301 meters), and other mountains that rise to the west of Denver and Colorado Springs. The *Sangre de Cristo* (Blood of Christ) Mountains are just south of the Front Range. Together, the Front Range and the Sangre de Cristo Mountains form a wall that faces the Great Plains to the east.

The Park Range, west of the Front Range, stretches from a point near the Wyoming border south to the beginning of the Arkansas River. South of the Park Range is the Sawatch Range, which includes Mount Elbert (14,433 feet, or 4,399 meters), the highest peak of the Rocky Mountains. The rugged San Juan Mountains occupy southwestern Colorado.

The mountains of Colorado surround many level, almost treeless areas called *parks.* The largest of these areas include North Park, Middle Park, South Park, and the San Luis Valley. See **Rocky Mountains.**

The Great Plains cover roughly the eastern two-fifths of Colorado. Colorado's Great Plains region is part of the vast Interior Plain of North America that stretches from Canada to Mexico. It slopes gently upward from east to west toward the base of the Rocky Mountains. Farmers once thought the area was too dry for farming. But irrigation projects in the valleys and dry farming on the higher lands have made large-scale agriculture possible (see **Dry farming; Irrigation**).

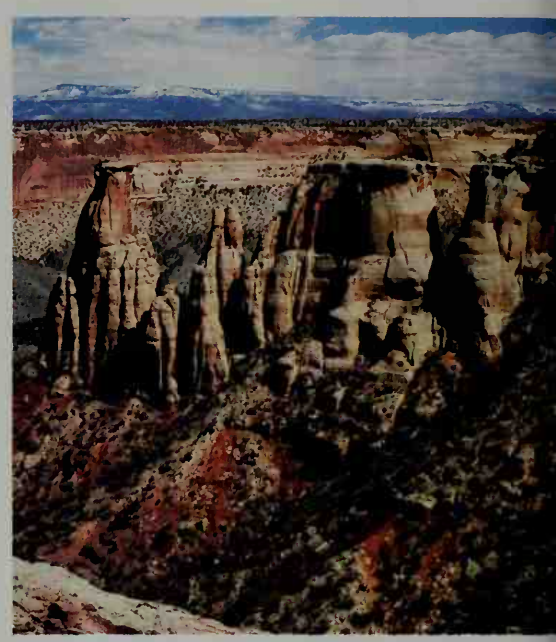
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OKLAHOMA
NEW MEXICO
ARIZONA
UTAH
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B
C
D
E
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50
100
150
200
250
300
350
400 Miles
0
50
100
150
200
250
300
350
400
450
500
550
600 Kilometers
ROCKY MOUNTAINS
Front Range
Sawatch Range
Sangre de Cristo Mountains
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Gore Range
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Medicine Bow Mts.
Elkhead Mts.
Elk Mountains
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San Luis Valley
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Pueblo
Fort Collins
Greeley
Boulder
Fort Morgan
Sterling
Yuma
Limon
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Lamar
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Trinidad
Walsenburg
Alamosa
Durango
Montrose
Delta
Gunnison
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Glenwood Springs
Aspen
Vail
Steamboat Springs
Craig
Canon City
Cheyenne
DINOSAUR NATIONAL MONUMENT
ROCKY MOUNTAIN NATIONAL PARK
COLORADO NATIONAL MONUMENT
BLACK CANYON OF THE GUNNISON NATIONAL PARK
CURECANTI NATIONAL RECREATION AREA
FLORISSANT FOSSIL BEDS NATIONAL MONUMENT
GREAT SAND DUNES NATIONAL MONUMENT
MESA VERDE NATIONAL PARK
Only point in the United States common to four state corners.
Mt. Zirkel 12,180 ft. (3,712 m)
South Bald Mtn. 11,003 ft. (3,354 m)
Hagues Peak 13,560 ft. (4,133 m)
Rabbit Ears Pass 9,426 ft. (2,873 m)
Longs Peak 14,255 ft. (4,345 m)
Pagoda Peak 11,120 ft. (3,389 m)
Sheep Mtn. 12,244 ft. (3,732 m)
Loveland Pass 11,992 ft. (3,655 m)
Baxter Mtn. 11,188 ft. (3,410 m)
Mt. Powell 13,533 ft. (4,125 m)
Monument Peak 9,196 ft. (2,803 m)
Mt. Evans 14,264 ft. (4,348 m)
Tennessee Pass 10,424 ft. (3,177 m)
North Mamm Peak 11,123 ft. (3,390 m)
Mt. Lincoln 14,286 ft. (4,354 m)
Bison Peak 12,431 ft. (3,789 m)
Snowmass Mtn. 14,092 ft. (4,295 m)
Mt. Elbert 14,433 ft. (4,399 m) Highest point in Colorado
Spinney Mtn. Res.
Mt. Harvard 14,420 ft. (4,395 m)
Pikes Peak 14,110 ft. (4,301 m)
Mt. Antero 14,268 ft. (4,349 m)
Mt. Ouray 13,970 ft. (4,258 m)
Monarch Pass 11,312 ft. (3,448 m)
Poncha Pass 9,010 ft. (2,746 m)
Uncompahgre Peak 14,309 ft. (4,361 m)
San Luis Peak 14,014 ft. (4,271 m)
Red Mtn. Pass 11,008 ft. (3,355 m)
Crestone Peak 14,294 ft. (4,357 m)
Greenhorn Mtn. 12,349 ft. (3,764 m)
Mt. Wilson 14,246 ft. (4,342 m)
Lizard Head Pass 10,222 ft. (3,116 m)
Windom Peak 14,082 ft. (4,292 m)
Hesperus Mtn. 13,232 ft. (4,033 m)
Wolf Creek Pass 10,856 ft. (3,309 m)
Summit Peak 13,300 ft. (4,054 m)
Blanca Peak 14,345 ft. (4,372 m)
North La Veta Pass 9,413 ft. (2,869 m)
West Spanish Peak 13,625 ft. (4,153 m)
Culebra Peak 14,069 ft. (4,288 m)
Fishers Peak 9,627 ft. (2,934 m)
Cumbres Pass 10,022 ft. (3,055 m)
Royal Gorge
South Platte River
Arkansas River
Colorado River
Rio Grande
Yampa River
White R.
Gunnison River
Dolores R.
San Miguel R.
Uncompahgre R.
Animas R.
San Juan R.
Los Pinos
Piedra R.
North Platte R.
Laramie R.
Cache la Poudre R.
Big Thompson R.
Republican River
South Fork Republican River
Arikaree River
North Fork Smoky Hill R.
Smoky Hill River
Purgatoire River
Apishapa River
Huerfano R.
Cucharas R.
St. Charles R.
Conejos R.
Cimarron River
North Fork Cimarron R.
Lodgepole Cr.
Frenchman Creek
Pawnee Cr.
Twomile Cr.
Crow Creek
Lone Tree Cr.
Wildcat Creek
Bijou Creek
Badger Creek
Beaver Creek
Kiowa Creek
Cherry Creek
Boxelder Cr.
Boulder Cr.
Horse Creek
Big Sandy Creek
Rush Creek
Adobe Creek
Pond Creek
Black Squirrel Cr.
Fountain Cr.
Beaver Cr.
Currant Cr.
Landsman Creek
Ladder Creek
White Woman Creek
Rule Creek
Timpas Creek
Chacuaco Cr.
Smith Canyon
Carrizo Creek
Two Buttes Creek
Bear Creek
Trinchera Cr.
Culebra Cr.
Saguache Cr.
Cochetopa Cr.
Taylor R.
Ohio Cr.
Crystal R.
Plateau Cr.
Roan Cr.
Piceance Cr.
Douglas Cr.
East Salt Cr.
West Salt Cr.
Disappointment Cr.
McElmo Cr.
Mancos R.
Navajo R.
Little Snake R.
Williams Fork
Illinois R.
Green R.
Shell Cr.
Julesburg Res.
Sterling Res.
Prewitt Res.
Jackson Res.
Riverside Res.
Empire Res.
Milton Res.
Horse Creek Res.
Bijou Res.
Barr Lake
Carter Lake
Halligan Res.
Grand L.
L. Granby
Williams Fork Res.
Green Mtn. Res.
Dillon Res.
Cherry Creek Res.
Cheesman L.
Antero Res.
Elevenmile Canyon Res.
Twin Lakes Res.
Ruedi Res.
Taylor Park Res.
Blue Mesa Res.
Morrow Point Res.
Paonia Res.
Rifle Gap Res.
Pueblo Res.
Lake Henry
Lake Meredith
Horse Creek Res.
Adobe Creek Res.
John Martin Res.
Great Plains Reservoirs
Lake McKinney
Two Buttes Res.
Bonny Res.
Cucharas Res.
Continental Res.
Rio Grande Res.
Platoro Res.
La Jara Res.
Sanchez Res.
Navajo Res.
Vallecito Res.
Electra L.
McPhee Res.
San Luis L.

Rivers and lakes. More important rivers begin in Colorado than in any other state. These rivers provide water for many states. Three major tributaries of the Mississippi-Missouri river system rise on the eastern slope of the Rocky Mountains. These are the Arkansas, South Platte, and Republican rivers. West of the Rockies, the Colorado River begins at Grand Lake, flows through Middle Park, and winds southwest into Utah. The Colorado drains a twelfth of all the land of the United States. Several of the chief tributaries of the Colorado, including the Uncompahgre, Gunnison, San Juan, and Dolores rivers, also rise in the state. The Rio Grande starts in the San Juan range, and flows east and south into New Mexico. The North Platte River flows north from North Park into Wyoming.

Rivers add much to Colorado's scenic beauty. Many have carved deep gorges, or tumble down mountains in lovely waterfalls and cascades. The Royal Gorge of the Arkansas River, west of Canon City, is more than 1,000 feet (300 meters) deep. A bridge that stands 1,053 feet (321 meters) above the floor of the Royal Gorge is the highest suspension bridge in the world. In some places, the Black Canyon of the Gunnison River in western Colorado is 2,400 feet (732 meters) below the surrounding land.

Many beautiful lakes lie in the mountains. Grand Lake, formed by glaciers, covers about 600 acres (240 hectares) near the town of Grand Lake. It is Colorado's largest natural lake. Summit Lake, 12,740 feet (3,883 meters) above sea level, is one of the highest lakes in the coun-



Tom Algire

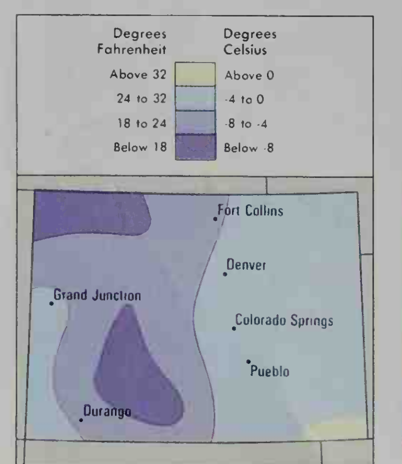
Unusual rock formations stand in the Colorado National Monument. They make up part of the Colorado Plateau, a region of high hills and deep valleys in western Colorado.

Average monthly weather

	Denver					Pueblo					
	Temperatures F°		C°		Days of rain or snow		Temperatures F°		C°		Days of rain or snow
	High	Low	High	Low			High	Low	High	Low	
Jan.	42	16	6	−9	6	Jan.	45	14	7	−10	5
Feb.	45	19	7	−7	6	Feb.	49	19	9	−7	4
Mar.	51	25	11	−4	8	Mar.	55	25	13	−4	6
Apr.	61	34	16	1	9	Apr.	65	35	18	2	7
May	69	43	21	6	11	May	73	45	23	7	10
June	81	52	27	11	9	June	84	54	29	2	7
July	87	58	31	14	9	July	90	60	32	16	9
Aug.	85	57	29	14	8	Aug.	88	59	31	15	9
Sept.	77	48	25	9	5	Sept.	81	49	27	9	4
Oct.	66	37	19	3	6	Oct.	69	37	21	3	4
Nov.	53	26	12	−3	5	Nov.	55	23	13	−5	4
Dec.	45	18	7	−8	4	Dec.	47	16	8	−9	3

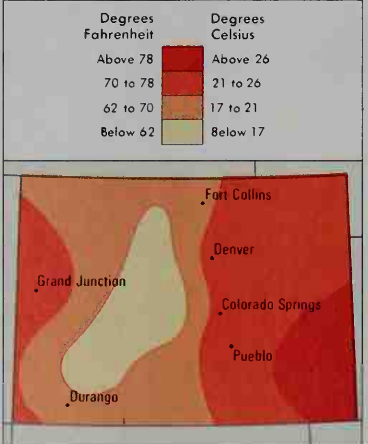
Average January temperatures

Wintertime temperatures vary widely in Colorado, with the western half of the state being much colder than the east.



Average July temperatures

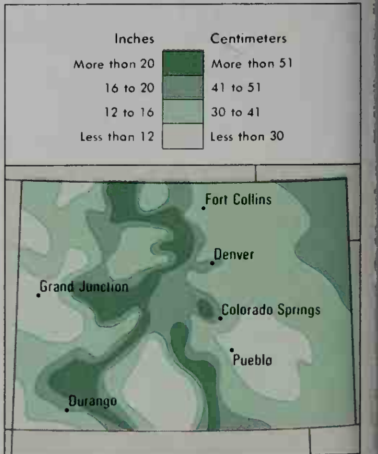
The plains and plateaus of Colorado are almost always warmer than the mountains in the summer.



Average yearly precipitation

Precipitation is distributed unevenly throughout the state. The western slopes receive the most rain and snow.

WORLD BOOK maps





Kent and Donna Dannen

Grasslands near La Junta in the Great Plains region of eastern Colorado are used for farming.

try. Many artificial lakes have been created by damming the rushing mountain streams. John Martin Reservoir, formed by a federal flood control project on the Arkansas River, is the largest lake. It covers more than 29 square miles (75 square kilometers) when full. The water is used for irrigation.

Plant and animal life. Because of the large differences in altitude and moisture, Colorado's land has a wide variety of plant life. Plants include many kinds of cactus, greasewood, sagebrush, and yucca in the drier areas. The chief grasses are buffalo and grama grass. Spring wildflowers include buttercups, sand lilies, wild geraniums, and yarrows. Summer brings columbines, dogtooth violets, Indian paintbrushes, mountain lilies and daisies, and wild irises and roses. Forests cover about a third of the state. Common trees found in Colorado include ashes, aspens, cottonwoods, firs, maples, pines, and spruces.

Hundreds of thousands of deer, elk, and other big game animals roam Colorado. Pronghorns and prairie dogs live on the plains. Fur-bearing animals include bears, beavers, bobcats, foxes, marmots, martens, rabbits, and skunks. Game birds include several kinds of grouse, pheasants, and quail. Colorado game fish include bass, catfish, crappies, perch, and trout.

Climate. Colorado's climate is generally dry and sunny. But because of the great differences in altitude, temperatures vary widely in short distances. The mountains are almost always cooler than the plains and plateaus. Burlington, on the plains, has an average January temperature of 28 °F (−2 °C). Leadville, in the mountains, has a January average of 18 °F (−8 °C). Average July temperatures are 74 °F (23 °C) in Burlington and 55 °F (13 °C) in Leadville. Colorado's highest temperature, 118 °F (48 °C), occurred at Bennett on July 11, 1888. Maybell in Moffat County had the lowest, −61 °F (−52 °C), on Feb. 1, 1985.

Colorado's average yearly precipitation is about 15 inches (38 centimeters). This moisture is not distributed evenly. The western slopes get the most rain and snow. The San Luis Valley, in southern Colorado, is the driest area of the state.

The dry air makes Colorado's climate comfortable. The sun warms the thin air quickly, especially at high altitudes. The *chinook,* a warm wind that occasionally blows down the eastern slopes in winter, can raise temperatures on the plains by 20 Fahrenheit degrees (11 Celsius degrees) or more in a short time.

Economy

Colorado's economy is divided roughly along the natural lines of its land. The Great Plains are the state's main farming region. Along the border between the Great Plains and Rocky Mountains lie Colorado's largest urban areas, where service industries and manufacturing are centered. The Rocky Mountains have many recreational areas, including some of the nation's favorite ski resorts. West of the Rockies lie the state's main petroleum, coal, and natural gas fields.

Service industries account for about four-fifths of Colorado's *gross state product*—the total value of all goods and services produced in a state in a year. Colorado's popularity as a site for vacations and conventions contributes to the strength of the state's retail trade. Tourists spend over $8 billion a year in Colorado. The state is also known for its growing high-tech sector, which is tied to both the service and manufacturing industries.

Natural resources. Mineral deposits, rich soils, and water are Colorado's greatest natural resources.

Soil. The soils of the Great Plains and the valleys of the western mountains are among the most fertile in the nation. The eastern soils are brown. In years of rainfall, they produce excellent crops. In dry years, the soil must be irrigated. The high mountains and some western plateaus have thin, stony soils called *lithosols.*

Minerals. Vast deposits of coal, gold, molybdenum, natural gas, and petroleum help support Colorado's economy. Huge oil shale deposits offer promise of future mineral development. Supplies of building materials, such as gravel, sand, and stone, are plentiful enough to meet the state's anticipated future needs.

Water is precious in the dry West. The control of water sources in the state is a continuing concern to Colorado's people. Six major rivers rise in Colorado. By agreement with other states and with Mexico, Colorado cannot use more than a specified amount of the water in these streams.

Distribution of water within the state is uneven. The *Western Slope* (land west of the Continental Divide) covers slightly more than a third of the land area. But it gets more than two-thirds of the *surface water* (runoff from rain and snow). The *Eastern Slope,* with almost two-thirds of the land area, gets less than a third of the surface water. There have been bitter legal and political fights over water rights within the state.

Many dams and tunnels have been built for *transmountain diversion* of water. Western Slope water is brought through tunnels in the mountains for use on the dry but heavily populated Eastern Slope. Some of this water goes to homes and factories. The rest is used to irrigate the fertile soil of the plains. These projects help solve eastern Colorado's water problems. The future growth of Colorado, both in manufacturing and agriculture, depends on the amount of water available.

Service industries contribute the largest portion of Colorado's gross state product. Most of the service industries in Colorado are found along the eastern side of the Rocky Mountains, from Fort Collins to Pueblo, and

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers: Number of people	Employed workers: Percent of total
Community, business, & personal services	23	875,300	32
Finance, insurance, & real estate	17	251,700	9
Wholesale and retail trade	16	587,200	22
Government	12	367,300	13
Transportation, communication, & utilities	12	145,300	5
Manufacturing	11	221,400	8
Construction	6	188,500	7
Mining	2	23,800	1
Agriculture	1	78,200	3
Total	100	2,738,700	100

*GSP = gross state product, the total value of goods and services produced in a year. Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.

are concentrated in the Denver metropolitan area.

Community, business, and personal services make up the leading service industry group in Colorado in terms of both the gross state product and employment. This group consists of many businesses, including private health care; hotels and ski resorts; and engineering, legal services, and software development. Colorado hotels benefit from the many conventions held in the state. Information technology and engineering companies receive much business from government agencies.

Finance, insurance, and real estate form the second-ranking service industry group in Colorado. Denver is an important regional banking and financial center. Several of the nation's leading insurance and investment firms have large branch offices in Denver.

Wholesale and retail trade ranks third among service industry groups in Colorado. Denver is the wholesale distribution center for the Rocky Mountain region of the United States. The wholesale trade of automobiles, groceries, and mined products is especially important. Major types of retail establishments include automobile dealerships, food stores, and restaurants. Retail merchants in the state receive much business from tourists.

Ranking next among service industries are (1) government and (2) transportation, communication, and utilities. Each of these groups contributes equally to Colorado's gross state product.

Government services include public schools and hospitals, and the military. The U.S. Air Force has extensive facilities in the Colorado Springs area, including the Air Force Academy and the North American Aerospace Defense Command. The federal government owns much of Colorado's unpopulated land. It controls grazing, logging, mining, and recreation there. State government offices are based in Denver.

Transportation, communication, and utilities are a growing service industry group in Colorado. Denver is one of the nation's major hubs of the airline, railroad, and trucking industries. Colorado is the home of Qwest Communications, Level 3 Communications, and Echostar Communications, some of the nation's leading telecommunications companies. A number of nationwide cable TV and direct TV companies are headquartered in Colorado. More information about transportation and communication appears later in this section.

Manufacturing. Goods manufactured in Colorado have a *value added by manufacture* of about $19 billion yearly. Value added by manufacture is the increase in value of raw materials after they become finished goods.

Computer and electronic products are the leading type of manufactures in Colorado in terms of value added by manufacture. About 60 percent of Colorado's exports come from this high-tech sector. Computers and devices that store computer data provide the most income for this industry. Manufacturers in Boulder, Colorado Springs, Denver, and Fort Collins make computer equipment. Other leading products are medical instruments and devices that measure electric current.

Food processing ranks second among Colorado's manufacturing activities. Beer brewing, soft drink bot-

Economy of Colorado

This map shows the economic uses of land in Colorado and areas where the state's leading farm and mineral products are produced. Major manufacturing centers are shown in red.

- Mostly cropland
- Grazing land
- Shrubland mixed with grassland
- Forest land
- Urban area
- Manufacturing center
- Mineral deposit



WORLD BOOK map

tling, and meat packing are major parts of the state's food-processing industry. Coors Brewing Company, the nation's third-largest brewer, is headquartered in Golden. Several breweries also operate in Fort Collins.

The state's other leading manufactured products include transportation equipment, chemicals, and fabricated metal products. Motor vehicle parts and aerospace equipment are important transportation products. Colorado's leading chemical products include medicines, cleaning materials, and paint. Factories in the Denver and Boulder areas manufacture metal doors and trim. Other important products made in the state include clothing, concrete, luggage, and printed materials.

Agriculture. Farmland covers about 60 percent of Colorado's land area. The state has about 29,000 farms. They range in size from large ranches to small *truck* (vegetable) farms.

Livestock and livestock products account for about two-thirds of the value of all Colorado farm products. Beef cattle are the leading farm product by far, and Colorado is a high-ranking state in beef cattle production. Grazing of cattle on ranches has been important for many years. Colorado farmers also *finish* (fatten) cattle in *feed lots.* Operators of feed lots put range cattle in relatively small pens. There, the cattle gain weight faster because they eat grain and other feed with high food value. Heavier animals bring better prices in the market. The Greeley area has the most feed lots. Colorado is also a leading producer of sheep for both meat and wool. Milk ranks among the state's most valuable farm products. Colorado farmers also raise hogs and poultry.

The chief field crops, in order of importance, are wheat, corn, and hay. Northeastern Colorado produces the most wheat and corn. Hay, which is used for cattle feed, grows in most parts of the state. Crop farmers also raise large amounts of beans, grain sorghum, potatoes, and sugar beets. Apples are Colorado's leading fruit crop. Greenhouse and nursery products are an important source of agricultural income. Greenhouses produce carnations prized for their size and beauty. Wine production is a growing industry in the state, especially in Mesa County.

Mining. Petroleum, coal, and natural gas are Colorado's chief mined products. Rio Blanco County in northwestern Colorado has the state's most productive oil fields. These fields yield about half of the state's total petroleum production. The area east of Denver also has important oil fields.

Northwestern Colorado is also the leading area for coal production. About half the state's coal comes from surface and underground mines in Moffat County. Surface mines in Rio Blanco County and underground mines in Routt County also have major coal production.

Large natural gas fields lie near Denver and Durango. The huge Hugoton field of the country's Interior Plains region extends into the southeast corner of Colorado.

Among Colorado's other mined products, sand and gravel, gold, and molybdenum provide the most income. Sand and gravel are obtained from pits along the rivers of the state's northern Great Plains region. Gold and molybdenum come from mines in the Rocky Mountains. Molybdenum is used in making strong varieties of steel. Some of the ores that contain gold or molybdenum also contain copper, lead, silver, and zinc. The nation's only diamond mine is in Colorado. The state also produces granite and limestone.



© Barry Staver

Meat packing is an important economic activity in Colorado. Food processing is one of the state's leading industries.

Colorado has large deposits of oil shale, a source of petroleum. Shale, a type of rock, is found in northwestern Colorado. Oil companies have been experimenting with extracting petroleum from shale since the 1920's. The high cost of processing remains a major obstacle.

Electric power. Plants that burn coal supply more than 90 percent of Colorado's electric power. Hydroelectric plants generate most of the rest of the electric power. Plants that burn natural gas and petroleum supply only a small amount of Colorado's power.

Transportation. Colorado has about 85,000 miles (137,000 kilometers) of roads and highways. In winter, highways that cross the mountains are kept open by snowplows. The 1.7-mile (2.7-kilometer) Eisenhower Memorial Tunnel carries motor traffic through the Rockies at about 11,000 feet (3,400 meters) above sea level. It is the world's highest road tunnel. The highest road in the United States climbs to the top of 14,264-foot (4,348-meter) Mount Evans, just west of Denver.

Denver International Airport is the state's major air terminal. Many passengers traveling to or from the West Coast change planes in Denver. Colorado Springs has the state's second busiest airport. A number of ski area airports have direct interstate flights during ski season.

Several major railroads operating within the state provide freight service. Passenger trains serve more than 10 Colorado cities. The 6.2-mile (10-kilometer) Moffat Tunnel, one of the longest U.S. railroad tunnels, goes through the Rockies in Colorado.

Communication. Colorado's oldest newspaper is Denver's *Rocky Mountain News,* first published in 1859. Today, Colorado has about 150 papers, including about 30 dailies. Leading papers include *The Gazette* of Colorado Springs, *The Denver Post, The Pueblo Chieftain,* and the *Denver Rocky Mountain News.* Colorado publishers also produce more than 300 periodicals.

The state's first commercial radio station, KFKA in Greeley, began broadcasting in 1921. KFEL-TV (now KWGN-TV) in Denver, Colorado's first TV station, began operation in 1952. Today, the state has about 185 radio stations and 25 television stations. Cable TV systems and Internet providers serve communities statewide.

Government

Constitution of Colorado was adopted in 1876. It has been *amended* (changed) about 100 times. All constitutional amendments must be approved by the people in an election. Amendments may be proposed by a two-thirds vote of the state legislature, by a petition of the voters, or by a constitutional convention. Such a convention requires the approval of two-thirds of the legislators and a majority of the people voting on the issue.

Executive. The governor and lieutenant governor of Colorado are elected to four-year terms. Voters cast one vote for both officials. Neither office may be held by one person for more than eight consecutive years.

The executive branch includes 20 principal departments. Three principal departments are under the direction of elected officials. These officials—the secretary of state, attorney general, and treasurer—are elected for four-year terms and may serve up to eight consecutive years. The governor, with the consent of the Senate, appoints most of the heads of the remaining departments.

Legislature, called the General Assembly, consists of a 35-member Senate and a 65-member House of Representatives. Senators serve four-year terms, and representatives serve two-year terms. Both are limited to no more than eight consecutive years in office. The Assembly begins its regular sessions each January, on or before the second Wednesday of that month. The length of a regular legislative session is limited to 120 days. A special session may be called by a vote of two-thirds of the members of the Senate and the House of Representatives.

Courts. Colorado's highest court is the Supreme Court, composed of a chief justice and six associate justices. The governor appoints the justices to the court. Justices are nominated for appointment by a commission of private citizens. After a justice serves for two years, he or she must win the approval of the voters in an election. If approved, the justice serves a 10-year term. The justice's later terms are also for 10 years, but he or she must be voted in each time.

Colorado's next highest court is the six-member Court of Appeals. Most major civil and criminal cases are tried in district courts in the state's 22 judicial districts. Appellate and district court judges are appointed and approved like justices. However, the appellate court judges serve full terms of eight years, and district court judges serve six years. District courts may act as probate or juvenile courts, except in Denver where those courts are separate. Each Colorado county has a county court, and larger towns have municipal courts.

Local government is carried on through 64 counties and about 260 cities and towns. The city and county of Denver operate as a single government, and so do the city and county of Broomfield. Each of the other 62 counties is governed by either three or five commissioners. The commissioners are elected by the voters to four-year terms. They may hold office for no more than eight consecutive years. However, voters in specific counties can elect to let their commissioners serve without term limits.

Communities with more than 2,000 people are called *cities,* and those with smaller populations are *towns.* Cities and towns may adopt *home rule* charters, which give them greater control over their own affairs. Under certain conditions, home rule charters and laws passed under such charters may replace state laws. The governing body of a town is called a *board of trustees,* and the governing body of a city is called a *council.* Most of the cities and towns have a chief administrative officer.

Revenue. State taxes provide over half of the state government's *general revenue* (income). A personal income tax, a sales tax, and a motor fuel tax produce the largest amounts. About a fourth of the revenue comes from federal grants and programs.

Politics. Colorado voters have elected about as many Democrats as Republicans to Congress. Voters in Denver and Pueblo usually support Democrats. Voters in Denver's suburbs and in northeastern Colorado generally favor Republicans.

Colorado has favored Republicans more often than Democrats in presidential elections. For Colorado's voting record in presidential elections, see **Electoral College** (table).

The governors of Colorado

	Party	Term		Party	Term
John L. Routt	Republican	1876-1879	**Julius C. Gunter**	Democratic	1917-1919
Frederick W. Pitkin	Republican	1879-1883	**Oliver H. Shoup**	Republican	1919-1923
James B. Grant	Democratic	1883-1885	**William E. Sweet**	Democratic	1923-1925
Benjamin H. Eaton	Republican	1885-1887	**Clarence J. Morley**	Republican	1925-1927
Alva Adams	Democratic	1887-1889	**William H. Adams**	Democratic	1927-1933
Job A. Cooper	Republican	1889-1891	**Edwin C. Johnson**	Democratic	1933-1937
John L. Routt	Republican	1891-1893	**Ray H. Talbot**	Democratic	1937
Davis H. Waite	Populist	1893-1895	**Teller Ammons**	Democratic	1937-1939
Albert W. McIntire	Republican	1895-1897	**Ralph L. Carr**	Republican	1939-1943
Alva Adams	Democratic	1897-1899	**John C. Vivian**	Republican	1943-1947
Charles S. Thomas	Democratic	1899-1901	**W. Lee Knous**	Democratic	1947-1950
James B. Orman	Democratic	1901-1903	**Walter W. Johnson**	Democratic	1950-1951
James H. Peabody	Republican	1903-1905	**Dan Thornton**	Republican	1951-1955
Alva Adams	Democratic	1905	**Edwin C. Johnson**	Democratic	1955-1957
James H. Peabody	Republican	1905	**Stephen L. R. McNichols**	Democratic	1957-1963
Jesse F. McDonald	Republican	1905-1907	**John A. Love**	Republican	1963-1973
Henry A. Buchtel	Republican	1907-1909	**John D. Vanderhoof**	Republican	1973-1975
John F. Shafroth	Democratic	1909-1913	**Richard D. Lamm**	Democratic	1975-1987
Elias M. Ammons	Democratic	1913-1915	**Roy Romer**	Democratic	1987-1999
George A. Carlson	Republican	1915-1917	**Bill Owens**	Republican	1999-

Early days. Hundreds of years before Europeans came to the Colorado area, Indians called the Anasazi built high cliff dwellings of stone along the canyon walls of a huge plateau in what is now southwestern Colorado. When the early European explorers arrived, they found the Arapaho, Cheyenne, Comanche, Kiowa, and Pawnee tribes on the plains. The Ute lived in the mountain valleys and on the Western Slope.

Exploration and settlement. Spanish explorers who came in the 1600's were the first Europeans to visit the Colorado region. The Spaniards failed to find gold and left without attempting to settle the area. In 1682, the explorer Robert Cavelier, Sieur de La Salle, claimed for France an area that included what is now eastern Colorado. In 1706, Juan de Ulibarri, a Spanish official, claimed the region for Spain.

In 1803, the United States bought present-day eastern and central Colorado as part of the Louisiana Purchase. During the next 20 years, Americans explored much of the region. Zebulon M. Pike, an Army officer, entered the Colorado area in 1806. Pike's record of the trip describes the mighty mountain that was named for him—Pikes Peak. Another officer, Major Stephen H. Long, led an exploring party in 1820. The first permanent American settlement was Bent's Fort, completed in 1833 near present-day La Junta. The fort, built by the trader William Bent, was used as a base by Kit Carson and other famous frontiersmen for trade in beaver pelts. Mexico won control of western Colorado from Spain in 1821. The United States took control during the Mexican War (1846-1848) and kept the land under the terms of the treaty that ended the war.

The gold rush. Colorado had few settlers until the late 1850's. Then, in 1858, prospectors found gold along Dry Creek near the site of present-day Denver. Gold hunters rushed into the area. "Pikes Peak or Bust" became the slogan of the prospectors as they traveled the long, hard trail to the Colorado gold fields. About 50,000 people had reached the area at the height of the rush, in 1859.

Governing the growing area became a major problem. The Indians claimed that the land had been given to them by various treaties. The miners ignored the Indian claims and set up what they called the Jefferson Territory. Congress refused to recognize the Jefferson Territory and created the Colorado Territory in 1861. William Gilpin was appointed as the first territorial governor. See **Jefferson Territory**.

Territorial days. Indians and whites fought many small clashes and three important battles during the 1860's and 1870's. In 1864, troops of the Colorado militia attacked a Cheyenne and Arapaho village at Sand Creek and killed about 150 Indians. This battle became known as the Sand Creek Massacre. The U.S. government criticized the attack and paid the Indians for their losses. In 1868, a large force of Indians attacked 50 Army scouts on the Arikaree River in eastern Colorado. The scouts fought for several days on Beecher Island in the river. They finally were saved by other troops.

The last big Indian battle in Colorado was the Meeker Massacre in 1879. In this fight, the Ute Indians killed their reservation agent, Nathan C. Meeker, and ambushed a body of troops. After the battle, a respected Ute chief named Ouray helped calm the Indian warriors and settle their problems with the whites.

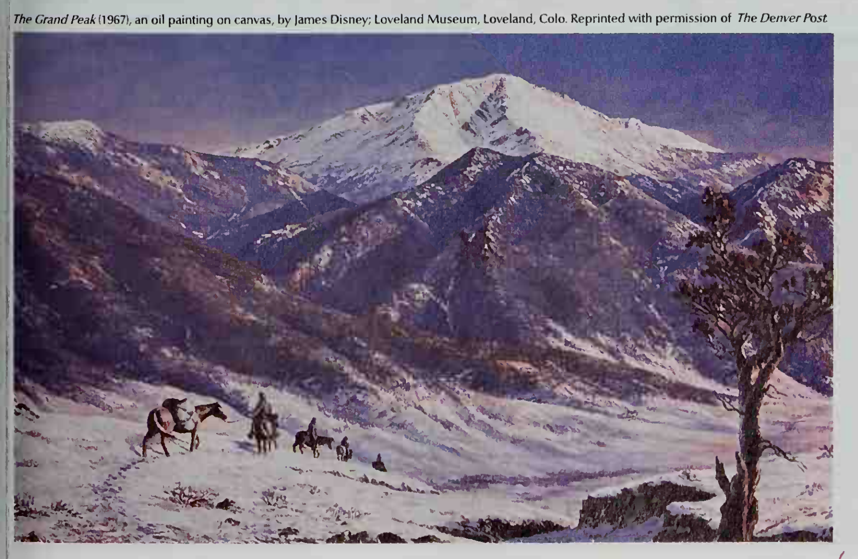
Many settlers started ranches and farms along the streams. Crude irrigation systems were developed along the eastern edge of the mountains, and in the San Luis Valley. In 1870, Horace Greeley, a famous New York City editor who believed in developing the West, helped sponsor a Colorado farming colony, which was later named for him. Greeley made popular the expression "Go West, young man."

In 1870, the Denver Pacific Railroad linked Denver with the main line of the Union Pacific at Cheyenne, Wyoming. This line connected Colorado and the East. The Kansas Pacific built its line to Denver later in 1870.

Statehood. Colorado was admitted to the Union on Aug. 1, 1876. Territorial governor John L. Routt was elected as the first state governor.

A new mining boom brought wealth to Colorado in the early years of statehood. This time silver caused the

The Grand Peak (1967), an oil painting on canvas, by James Disney; Loveland Museum, Loveland, Colo. Reprinted with permission of *The Denver Post*



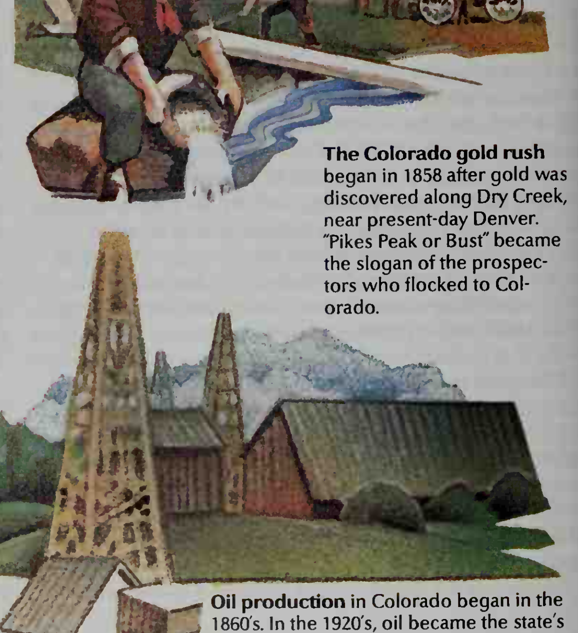
American exploration of Colorado began during the early 1800's. Colorado's most famous land feature, Pikes Peak, *shown here,* was sighted in 1806 by American Army officer Zebulon Pike. The mountain is named for him.

Historic Colorado



Bent's Fort, the first permanent American settlement in Colorado, was completed in 1833 near present-day La Junta. Named for William Bent, a trader in the region, it was a base for such pioneers as Kit Carson.

Union Colony, a cooperative agricultural community in the South Platte Valley, was sponsored by the famous New York City editor Horace Greeley in 1870. The colony is now the town of Greeley.



The Colorado gold rush began in 1858 after gold was discovered along Dry Creek, near present-day Denver. "Pikes Peak or Bust" became the slogan of the prospectors who flocked to Colorado.

The U.S. Air Force Academy was founded at Colorado Springs in 1958.

Oil production in Colorado began in the 1860's. In the 1920's, oil became the state's most important mineral product.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Colorado

1706 Juan de Ulibarri claimed the Colorado region for Spain.

1803 The United States acquired eastern Colorado as part of the Louisiana Purchase.

1806 Zebulon M. Pike explored Colorado.

1848 The United States took western Colorado after the Mexican War.

1858 Gold was discovered at Dry Creek, near the site of what is now Denver.

1859 The Colorado gold rush attracted thousands of prospectors and settlers.

1861 Congress created the Colorado Territory.

1870 The Denver Pacific Railroad was completed to Denver.

1876 Colorado became the 38th state on August 1.

1899 The state's first beet-sugar factory began operating.

1906 The U.S. Mint in Denver issued its first coins. Congress established Mesa Verde National Park.

1915 Rocky Mountain National Park was established.

1927 The Moffat Tunnel, a railroad tunnel through the mountains, was completed.

1956 The Colorado River water storage project was approved by Congress.

1958 The U.S. Air Force Academy's permanent campus opened near Colorado Springs.

1959 The Colorado-Big Thompson irrigation system was completed.

1962 Ground was broken for the three-dam Curecanti water storage system (now the Wayne N. Aspinall Storage Unit). The system was completed in 1976.

1966 North American Air Defense Command—now North American Aerospace Defense Command—completed its operations center in Cheyenne Mountain.

1985 The Frying Pan-Arkansas Project, which transfers water across Colorado, was completed.

1999 Black Canyon of the Gunnison National Monument was made a national park.

growth. Leadville and Aspen boomed as silver centers.

Horace A. W. Tabor became the symbol of this colorful era. He was called the *Silver King.* With his profits from several mines, Tabor built magnificent buildings in Leadville and Denver. His investments in Denver helped that frontier town become a business and financial center. Tabor became a U.S. senator. President Chester A. Arthur attended Tabor's wedding to the beautiful Elizabeth "Baby" Doe.

In 1893, business slumped all across the nation. For this reason, the U.S. government canceled its agreements to buy large amounts of silver. Silver prices dropped. In Colorado, many silver mines closed and the miners lost their jobs. Other businesses suffered because people who were unemployed could not afford to buy their products.

Progress as a state. Colorado's growth continued in spite of the state's troubles. A major gold discovery at Cripple Creek softened the blow of the silver crash. Farmers tried different crops, and expanded their irrigation systems. Sugar beets and potatoes became valuable Colorado crops. The state's first sugar refinery opened in Grand Junction in 1899. In 1902, construction started on a railroad over the Continental Divide. In 1906, the U.S. Mint in Denver produced its first coins.

By 1910, Colorado had almost 800,000 people. Agriculture had replaced mining as the state's most important industry. Colorado had more irrigated land than any other state. The food processing industry grew as canneries and more sugar refineries were built.

The 1910's and 1920's. The development of automobiles in the early 1900's caused rapid growth in two Colorado industries—oil and tourism. The family car made vacation travel easier, and Colorado's splendid scenery attracted thousands of tourists. Cars also increased the demand for petroleum products. Colorado's first oil wells were drilled in the Arkansas Valley during territorial days, but production was small. Later, new oil fields were discovered. By 1920, oil had become Colorado's most important mineral product.

The state government kept pace with the advances in industry. For example, a plan of workers' compensation was passed in 1915. In 1927, the famous Moffat railroad tunnel was completed with state funds.

The Great Depression. Colorado's economy suffered during the Great Depression of the 1930's. Farm prices dropped sharply and stayed low. A long period of dry weather began on the Great Plains. Wind whipped the dry, powdery soil into huge dust clouds, and dust storms darkened the sky. The state and federal governments began programs to restore the wind-damaged land and to help the unemployed. In 1935, the state adopted a 2 percent sales tax to raise money for old age pensions. Highway construction and other programs helped put the unemployed back to work.

The mid-1900's. Colorado's economy boomed during World War II (1939-1945). The war brought a great demand for Colorado metals and oil. The government established several air bases in the state and several federal agencies in the Denver area. The army opened Fort Carson near Colorado Springs and a huge ordnance plant at Pueblo. Military payrolls in Colorado jumped from $3 million in 1940 to $152 million in 1945.

The population of the state increased after World War II, and Colorado began to rank as one of the nation's fastest growing states. Many suburbs developed around major cities in central Colorado.

With the population growth, Colorado's need for flood control, irrigation, and water storage became severe. Central Colorado and the Great Plains have often suffered either long droughts or sudden floods. Cherry Creek Dam near Denver was completed in 1949. In 1947, the Alva B. Adams Tunnel was completed. This tunnel carries water through the Rocky Mountains from western Colorado to the area northeast of the mountains. It is part of the huge Colorado-Big Thompson Project, which was completed in 1959. This project is a series of dams, pumping stations, reservoirs, and tunnels that irrigates about 720,000 acres (291,000 hectares) of farmland. It also includes six hydroelectric power plants.

More federal offices and military installations were established in Colorado during the 1950's. The laboratory of the National Bureau of Standards (now the National Institute of Standards and Technology) moved from Washington, D.C., to Boulder in 1954. The United States Air Force Academy opened its Colorado Springs campus in 1958. The North American Air Defense Command (NORAD) combat operations center made its headquarters near Colorado Springs. The center, now called the North American Aerospace Defense Command, was completed in 1966. It is 1,200 feet (366 meters) underground in Cheyenne Mountain.

By 1954, manufacturing had replaced agriculture as the state's leading industry. The larger manufacturing plants produced atomic warheads, missiles, and other military items. The manufacture of electronic parts and the mining and milling of uranium became important industries in western Colorado.

Work on the Colorado River Storage Project began in 1956. A major part of this project was the Wayne N. Aspinall Storage Unit on the Gunnison River in central Colorado. This unit, completed in 1976, included power plants, reservoirs, and water purification systems. It was designed to bring water for irrigation, energy, and recreation in Colorado. The project spreads across five other states, along the Colorado River and its tributaries.

In the early 1960's, work began on the Frying Pan-Arkansas Project. The project was designed to transfer water from western Colorado to the plains in the eastern part of the state. The project began operation in 1972 and was completed in 1985.

The late 1900's. In 1976, floodwaters of the Big Thompson River swept through an area of homes, summer cabins, trailer camps, and vacation resorts in Big Thompson Canyon, near Loveland. The flood, which was caused by heavy rains, killed more than 135 people.

Colorado, particularly the Denver area, became a center for energy-related activities in response to the nationwide energy shortage that developed during the 1970's. Energy companies in Colorado expanded their operations. These firms planned to develop Colorado's vast deposits of coal, natural gas, oil shale, and petroleum. The expansion in energy-related fields resulted in tremendous population growth during the late 1970's and early 1980's. This energy boom later collapsed, and by the mid-1980's, the state faced an economic slump. However, economic improvement took place in the late 1980's and in the 1990's.

Early 2000's. Colorado remains one of the fastest growing areas in the United States. The state continues to face such problems as air and water pollution, overcrowding along the eastern edge of the Rocky Mountains, and urban decay. Agriculture, mining, and population have declined in the state's rural areas. For future progress, the state's leaders believe, Colorado requires improved economic and urban planning and an adequate supply of clean water.

John L. Dietz and Duane A. Smith

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Questions

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What projects help solve the water problems in eastern Colorado?
What is the origin of Colorado's name?
Why was H. A. W. Tabor important to Denver?
Where is the highest road in the United States?
What is Colorado's leading farm product?
What military defense center is underground in Colorado?
Why is Colorado called the Centennial State?
What mountains are called the Roof of North America?

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Colorado, University of, is a state-supported coeducational university with campuses in Boulder, Colorado Springs, and Denver. It also has a health sciences center in Denver. The university offers courses in arts and sciences, business, education, engineering and applied sciences, environmental design, law, and other fields. The health sciences center includes schools of dentistry, medicine, nursing, and pharmacy. The University of Colorado grants bachelor's, master's, and doctor's degrees.

The Boulder campus includes the Laboratory for Atmospheric and Space Physics, Sommers-Bausch Observatory, Nuclear Physics Laboratory, and several research institutes. In Boulder, the university holds a Conference on World Affairs every spring and several fine arts festivals during the summer. The university was founded in 1876. Critically reviewed by the University of Colorado

Colorado Desert occupies about 2,000 square miles (5,200 square kilometers) of southeastern California. It lies between the Santa Rosa and Coast ranges on the west and the Colorado River on the east (see **California** [physical map]). The desert also extends south into northwestern Mexico. The Mojave Desert lies north and northwest of the Colorado Desert. Parts of the Colorado Desert are 245 feet (75 meters) below sea level. The desert's Eagle Mountain is a valuable source of iron ore. The Imperial and Coachella valleys are rich farming regions. A number of geothermal power plants in or near Imperial Valley turn heat from the earth into electrical energy (see **Imperial Valley**). John Edwin Coffman

Colorado National Monument, in western Colorado, includes many strange rock formations, such as Devil's Kitchen, Window Rock, and Independence Monument. It also has prehistoric remains and a wildlife preserve. The Colorado National Monument was established in 1911. For its area, see **National Park System** (table: National monuments).

Critically reviewed by the National Park Service

Colorado River, one of the major rivers in the United States, is 1,450 miles (2,334 kilometers) long. It flows across 1,360 miles (2,189 kilometers) of the United States and 90 miles (145 kilometers) of Mexico. It rises in the Rocky Mountains of Colorado and flows southwest into Utah. It is joined by the Green River in eastern Utah and

by the San Juan River in southern Utah. The Colorado then continues southwest into Arizona. After merging with the Little Colorado River in northern Arizona, the river swings west through the Grand Canyon. The Virgin River of Nevada joins its course beyond the Grand Canyon. The Colorado then turns south and forms the Arizona-California border. It then flows across the Mexican border to the Gulf of California. Arizona's Bill Williams and Gila rivers merge with the river north of the Mexican border. The Colorado drains an area of about 250,000 square miles (650,000 square kilometers).

The Grand Canyon of the Colorado River presents an outstanding example of the effects of wind, water, and weather on the earth's surface. For millions of years, the river worked its way into layer after layer of rock, gradually deepening and broadening its channel. Sand, pebbles, and boulders carried by the river produced a constant grinding action. The action of wind and temperature and the gradual elevation of the Colorado plateau added to the effect of the grinding. The Grand Canyon now consists of a great gash in the earth 1 mile (1.6 kilometers) deep. It ranges from less than 1 mile to 18 miles (29 kilometers) wide.

Many rapids and waterfalls lie along the course of the Colorado. The waters carry tons of silt and sand. Until Hoover Dam was built, the river deposited these materials in its lower river valley, forming a rich delta country in Mexico. The Hoover Dam, completed in 1936, helps check floods and erosion, and provides a dependable supply of water and electric power. Davis, Parker, and Imperial dams, which lie downstream from Hoover Dam, also help regulate the flow of water. In 1956, Congress passed a bill providing for the construction of four major power dams and a number of water-supply units on the Colorado and its branches. The Navajo Dam was completed in 1963, and the Flaming Gorge and Glen Canyon dams were completed in 1964. The Colorado-Big Thompson Project diverts water from the Colorado. The water is used to irrigate 720,000 acres (291,000 hectares) of land in northeastern Colorado.

In 1963, a plan was announced to develop wildlife preserves and recreation areas along the banks of the lower Colorado River. Since that time, two wildlife preserves were expanded, and a new preserve was established. Two state parks and other recreational areas were developed. Lay James Gibson

See also Grand Canyon; Hoover Dam.



WORLD BOOK map

The route of the Colorado River

Colorado Springs, Colorado (pop. 360,890; met. area pop. 516,929), is a tourist and recreation center in the Rocky Mountains. It lies 6,035 feet (1,839 meters) above sea level, east of Pikes Peak. For location, see Colorado (political map). Colorado Springs has a healthful climate, with an average of more than 300 days of sunshine. It is the state's second largest city. Denver is the largest.

Colorado College, Colorado Tech (formerly Colorado Technical College), and the University of Colorado at Colorado Springs are located in the city. Points of interest include the Garden of the Gods, Pikes Peak, the Will Rogers Shrine of the Sun Memorial, and the Prorodeo Hall of Champions & Museum of the American Cowboy. The city is also the site of the United States Olympic Training Center.

The United States Air Force Academy is north of Colorado Springs. Other military installations include the headquarters of the North American Aerospace Defense Command (NORAD), with its command center located under Cheyenne Mountain; Fort Carson, home of the U.S. Army's 4th Infantry Division; Peterson Air Force Base, home of the U.S. Space Command and 1st Space Wing; and Schriever Air Force Base, home of the Consolidated Space Operations Center.

Colorado Springs's industries include the research and development of space technology as well as other electronics research and assembly work. Other areas of industry include plastics and metals processing, and printing and publishing. The city was founded in 1871. It has a council-manager form of government and is the seat of El Paso County. Dru Wilson

Colosseum, *KAHL uh SEE uhm,* also called the Flavian Amphitheater, *FLAY vee uhn AM fuh thee uh tuhr,* was the largest outdoor theater of ancient Rome. The Colosseum still ranks among the finest examples of Roman architecture and engineering, even though it survives only as a ruin. It stands near the center of modern Rome.



D. and J. Heaton, Colorific Photo Library Ltd

The Colosseum, or Flavian Amphitheater, in downtown Rome, is one of the most famous ruins in the world. The classical Roman structure rises to a height of four stories on one side.

Construction of the Colosseum started during the reign of the Emperor Vespasian, who ruled from A.D. 69 to 79. The building was dedicated in A.D. 80. Until 404, the Colosseum was the site of mock naval battles, combat between gladiators, battles between men and wild animals, and other public entertainment. After that date, gladiatorial battles were no longer held, but fights with wild animals continued there until 523. During the Middle Ages, stones from the structure were used to construct new buildings.

The Colosseum has four stories and is oval in shape. It could seat about 50,000 spectators on marble and wooden benches. The Colosseum is 157 feet (48 meters) high, about 620 feet (189 meters) long, and about 510 feet (155 meters) wide. The arena on the floor of the Colosseum is about 285 feet (87 meters) long and 180 feet (55 meters) wide. A wall about 15 feet (4.6 meters) high separated spectators from the arena.

The Colosseum is made of brick and concrete with stone covering the exterior. The first three stories consist of arches decorated with half columns. A plainer fourth story was added later. The Colosseum had about 80 entrances, 2 reserved for the emperor. Passages and chambers ran beneath it. William J. Hennessey

See also **City** (picture: Rome).

Colossians, *kuh LAHSH uhnz,* **Epistle to the,** is the 12th book of the New Testament. It is a letter from the apostle Paul to the Christians in Colossae (in what is now western Turkey). Some scholars doubt that Paul actually wrote the letter. They believe it was written in his name by one of his followers. If Paul wrote Colossians, he did so while in prison, possibly in Rome, in about A.D. 60. Colossians is mainly a warning against combining Christianity with a "philosophy" (Col. 2:8) that involved Jewish observances among other things. The author argued that faith in Jesus is completely sufficient, and that nothing need be added to it. See also **Paul, Saint; Bible** (Books of the New Testament). Terrance D. Callan

Colossus of Rhodes. See Seven Wonders of the Ancient World.

Colostomy, *kuh LAHS tuh mee,* is a surgical procedure that creates an opening between the *colon* (part of the large intestine) and the surface of the body. Patients usually must wear a bag over the opening to collect *stool* (solid waste matter) from the digestive tract. Normally, stool is expelled from the body through the *anus,* an opening at the lower end of the large intestine.

A colostomy may be permanent or temporary. Permanent colostomies are most common in patients with cancer of the rectum or colon. Treatment of the cancer may require disconnecting the colon from the anal canal to remove the diseased section of the intestine, and reconnection may not be possible. Other conditions that may necessitate a permanent colostomy include severe cases of diseases that inflame or infect the colon, such as *Crohn's disease, diverticulitis,* or *ulcerative colitis.* Surgeons often create temporary colostomies in emergencies—for example, to remove intestinal blockages or repair gunshot or stab wounds. The colostomy is removed after the colon heals.

In most permanent colostomies, doctors divide the colon and stitch one end to an opening made in the skin at the abdomen. This is called an *end colostomy.* Most temporary colostomies are *loop colostomies.* In this type, a loop of the colon is brought through the abdominal wall, opened, and stitched to the skin.

Patients can learn to live with colostomies with a minimum of inconvenience. Specially trained nurses teach patients how to take care of the colostomy and surrounding skin. Many patients get advice and emotional support from other colostomy patients.

James L. Franklin

Colour. See Color.

Colt. See Horse.

Colt, Samuel (1814-1862), developed the first successful repeating pistol. The pistol was patented in England in 1835. The pistol had a cylinder of several chambers that could be discharged in succession by the same locking and firing mechanism (see **Handgun**).



Wood engraving (1856) by H. Wright Smith; The New York Public Library, New York City

Samuel Colt

Colt established a factory at Hartford, Connecticut, where he produced arms that were used in the Mexican War (1846-1848) and during the Civil War (1861-1865). After Colt's death, his company made the six-shooters that were used throughout the West. Colt was born in Hartford.

Merritt Roe Smith

Colter, John (1775?-1813), an American explorer, was the first white person to visit the area that is now Yellowstone National Park. Colter joined the Lewis and Clark expedition in 1803. In 1806, he left the expedition early and spent an additional four years in the Western wilderness. In 1807, he traveled through the Yellowstone region. His reports of hot springs and geysers there led people to call the area "Colter's Hell."

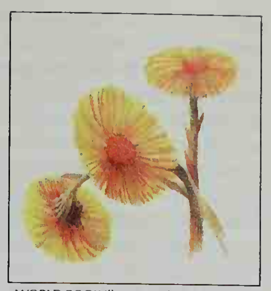
In the wilderness, Colter led trappers to rich new sources of fur-bearing animals. In 1808, he explored the area around the headwaters of the Missouri River, near what is now Three Forks, Montana. The area was a good source of beaver, but it was guarded by the Blackfeet Indians. The Blackfeet captured Colter, stripped him naked, and told him to run for his life. He escaped, and the story of his run became famous.

In 1810, Colter settled in Missouri. He was born near Staunton, Virginia. Gary E. Moulton

Coltrane, John William (1926-1967), was a jazz saxophonist and composer. His sometimes violent style made him one of the most controversial and widely imitated jazz musicians of the 1960's. He was one of the first jazz artists to reflect the influence of the music of India. His best-known compositions are "Giant Steps" (1959), "Equinox" (1960), and "Impressions" (1961).

Coltrane was born in Hamlet, North Carolina. He played in the bands of Dizzy Gillespie and Johnny Hodges during the early 1950's. He achieved greater recognition as a frequent soloist with the Miles Davis quintet between 1955 and 1960. Coltrane formed his own quartet in 1960, and scored a popular success with a recording of the song "My Favorite Things." Coltrane did much to popularize the soprano saxophone among jazz musicians. Frank Tirro

Coltsfoot is a wild plant native to Europe and Asia. It also grows in the northeastern part of the United States and in Canada. The coltsfoot has light-yellow, daisylike flowers that bloom in March or April. The plant's large leaves grow after the flowers have withered. The leaves are downy on the underside. They are round at first but later become shaped like a heart or a colt's foot. *False coltsfoot* and *beetleweed* are not true coltsfoot plants. David J. Keil


WORLD BOOK illustration by Robert Hynes
Coltsfoot

Scientific classification. The coltsfoot is in the composite family, Asteraceae or Compositae. It forms the genus *Tussilago.*

Colugo. See Flying lemur.

Colum, *KAHL uhm,* **Padraic,** *PAW drihk* (1881-1972), was an Irish playwright, poet, biographer, short-story writer, essayist, folklorist, and children's author. He was an original member of the group of Irish writers who made Dublin's Abbey Theatre famous. Colum wrote three important plays for the Abbey—*Broken Soil* (1903, revised as *The Fiddler's House), The Land* (1905), and *Thomas Muskerry* (1910). Each is a realistic study of peasant or provincial life in Ireland.

Colum was born in County Longford, and moved to the United States in 1914. He then began writing young people's books based on myth and folklore. These books include *The Adventures of Odysseus* (1918) and *The Children of Odin* (1920). These works are important for bringing classical literature to children.

Colum's verse—from *Wild Earth* (1907) to *Collected Poems* (1953)—is a subtle rendering of simple speech and song patterns. Colum's verse is clear in style and nostalgic in feeling. With his wife, Mary, Colum wrote *Our Friend James Joyce* (1958). Edward Hirsch

Columbia is a name sometimes used in referring to the United States. Long before the Revolutionary War in America (1775-1783), many people felt that America should have been named Columbia after the explorer Christopher Columbus. During the war, colonial poets used the name to describe the new nation that was to become the United States. Phillis Wheatley, for example, a black slave poet in Massachusetts, used the term in a poem honoring George Washington. Philip Freneau, a poet and journalist, popularized the term in several poems during and after the Revolutionary War. In 1784, King's College in New York City became Columbia College. Towns, counties, and institutions throughout the United States have since adopted the name.

Many artists have symbolically pictured Columbia as a tall, stately woman dressed in flowing garments and holding an American flag. A blue drape with white stars is usually part of her costume. The earliest image of Columbia showed her as an American Indian woman. In the 1800's, she appeared on the prows of ships, in patriotic paintings, and in pageants representing the Revolutionary War. The *Statue of Freedom,* on top of the U.S. Capitol in Washington, D.C., is often incorrectly identified as a statue of Columbia. Donna J. Spindel

Columbia, Missouri (pop. 84,531; met. area pop. 135,454), is an important regional center of education and health care. Columbia is one of Missouri's largest cities. It lies about midway between St. Louis and Kansas City (see **Missouri** [political map]).

Columbia is the home of the main campus of the University of Missouri, which was founded in 1839 as the first state university west of the Mississippi River. The university's school of journalism, which opened in 1908, is the oldest in the world. Stephens College and Columbia College are also in the city. Many of Columbia's workers are employed by the city's hospitals and clinics, which include the University of Missouri-Columbia Hospital & Clinics, Boone Hospital Center, and a veterans' hospital. Columbia serves as a major center of retail and agricultural trade for the surrounding region. MFA, Inc. (Missouri Farmer's Association), an agricultural cooperative that operates throughout the Midwest, has its headquarters in the city. Several insurance companies also have their home offices in Columbia.

The Smithton Land Company founded a village near what is now Columbia in 1819. Columbia was incorporated in 1826. It is the seat of Boone County and has a council-manager government. George Kennedy

Columbia, South Carolina (pop. 116,278; met. area pop. 536,691), is the state's capital and largest city. It is South Carolina's trading center and a popular tourist destination. The city lies in the central part of the state, on the Congaree River, near the junction of the Broad and Saluda rivers (see **South Carolina** [political map]).

Columbia, the seat of Richland County, covers about 108 square miles (280 square kilometers). The metropolitan area spreads across 1,529 square miles (3,960 square kilometers) and extends into Lexington County.

The federal, state, county, and local governments employ many workers in the Columbia area. The city has over 300 factories. Chief industries include chemicals, concrete products, electronics equipment, lumber, metal products, processed foods, and textiles. The State Farmers Market in Columbia is a leading farm products market of the Southeast.

Historic buildings in Columbia include the First Baptist Church, built in 1859, and the state capitol, called the State House. In 1860, the Secession Convention met in the church to discuss the possibility of South Carolina's leaving the Union. The State House still bears scars from shells fired during the American Civil War (1861-1865).

Other attractions in Columbia include the Columbia Museum of Art, the Governor's Mansion, the historic Columbia Canal, President Woodrow Wilson's boyhood home, Riverbanks Zoo and Botanical Garden, Riverfront Park, and the South Carolina State Museum. The Town Theatre, established in 1919, is one of the oldest little theaters in the United States. Columbia has a symphony orchestra and is the home of Allen University, Benedict College, Columbia College, the University of South Carolina, and other educational institutions.

Columbia has a council-manager form of government. Six council members and a mayor are elected to four-year terms. The council appoints a city manager to supervise the city's business.

Congaree Indians lived in what is now the Columbia area until the early 1700's, then moved north. White settlers built farms and cotton plantations in the area. In

1786, the South Carolina Legislature voted to move the state capital from the coastal city of Charleston to the middle of the state. The legislators called the new capital *Columbia,* a name poets had used for the country. The Legislature first met there in 1790. In the 1800's, cotton milling became one of Columbia's most important industries. Columbia grew until the Civil War began in 1861. It began to grow again by the 1880's. Many textile mills expanded, and new industries came to the area.

In the late 1960's, the city began a program to beautify Columbia and encourage more people to make use of the downtown area. Several office buildings were constructed during the 1970's and 1980's. In the 1990's, the city worked to beautify Columbia's waterfront. New parks and other public improvements attracted businesses and shops to the waterfront area. Eileen Waddell

See also South Carolina (pictures).

Columbia River is one of the chief rivers of the Western United States and Canada. It is the second longest river in the Western Hemisphere that flows into the Pacific Ocean. Only the Yukon River is longer. The Columbia is 1,243 miles (1,995 kilometers) long. It drains an area of about 250,000 square miles (647,000 square kilometers), mostly in the United States.

Dams on the river generate about a third of the hydroelectric power produced in the United States. The Columbia is also a major source of water for irrigation.

The Columbia was named by Captain Robert Gray of Boston, who sailed into the mouth of the river in 1792. Gray named the river for his ship. In 1805, the American explorers Meriwether Lewis and William Clark traveled down the Columbia during their historic expedition to the Pacific Coast. In 1811, the Canadian explorer David Thompson became the first white person to navigate the entire length of the river.

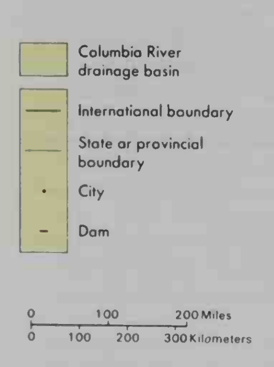
The course of the Columbia. The Columbia River begins in Columbia Lake, which lies in the southeastern part of the Canadian province of British Columbia. From there, it flows northwest for about 200 miles (320 kilometers), bounded by the Canadian Rockies on the east and the Selkirk Mountains to the west. The river curves around the Selkirks and then flows south to the Canadian-U.S. border. About 100 miles (160 kilometers) after entering the state of Washington, the Columbia begins a large curve westward. As the river continues to flow west to the Pacific Ocean, it forms the boundary between Washington and Oregon. The river passes through the Cascade Range by way of the Columbia River Gorge. The mouth of the Columbia forms a deep harbor on the Pacific Coast. Astoria, Oregon, an important fishing port, lies at the mouth of the river.

Hydroelectric power and irrigation. Fourteen large dams on the Columbia—11 in the United States and 3 in Canada—provide water for hydroelectric power and irrigation. Grand Coulee Dam, about 90 miles (140 kilometers) northwest of Spokane, Washington, is the greatest single source of water power in the United States. Inexpensive electricity produced by the Columbia River dams has encouraged industrialization in the Pacific Northwest, including aluminum plants along the river and aircraft factories in Seattle and other cities in Washington. Irrigation water provided by the dams has turned millions of acres of arid land into a productive farm region. Also, reservoirs created by the dams are used for boating, fishing, swimming, and other activities. The dams also control flooding by the river.

Commerce. Large ocean vessels travel on the Columbia between the Pacific Ocean and Portland, Oregon. Smaller vessels go from the ocean through the locks of Bonneville Dam and continue upriver to Pasco, Washington. Canals and lock systems also permit barges to use the lower part of the Columbia and to sail up the Snake River to Lewiston, Idaho. Cargoes transported on the Columbia include grain, forest products, iron and

Columbia River

The Columbia River rises in the Canadian Rockies and drains southeastern British Columbia and much of the Pacific Northwest. More than 50 dams make the river's drainage basin the greatest center of water power in the world.





WORLD BOOK map

steel products, and petroleum products.

Wildlife of the Columbia River includes such fishes as perch, salmon, and trout. In the Canadian Rockies, forests of fir, larch, hemlock, and spruce trees grow along the river. These mountain areas are the home of bears, bighorn sheep, moose, and timber wolves. Bobcats, coyotes, and elk live in the grasslands that border the river in the United States. John Edwin Coffman

See also **Bonneville Dam; British Columbia** (The mid-1900's); **Grand Coulee Dam; Gray, Robert; Oregon; Washington.**

Columbia University is a coeducational, privately endowed university in New York City. The university lies in upper Manhattan. Columbia is a leading university in liberal arts and professional studies.

Its divisions include 16 graduate and undergraduate schools. More than half of the students are enrolled in graduate schools. These schools include those of architecture and planning, arts and sciences, business, engineering, international affairs, journalism, law, library service, public health, and social work; and the college of physicians and surgeons. Columbia's undergraduate programs include courses in arts, engineering, and nursing. The university's undergraduate schools include Columbia College, which offers a core curriculum in contemporary civilization and the humanities. The university also has a School of General Studies. It provides undergraduate liberal arts courses for adults.

Affiliated institutions. Two colleges in New York City are affiliated with Columbia University. Barnard College was established by the trustees of Columbia University as an undergraduate school for women. It was founded in 1889 and awarded its first bachelor's degrees in 1893. Barnard students now attend classes at Columbia and receive degrees from the university.

Teachers College is a graduate school of education. Its programs lead to master's and doctor's degrees. Teachers College was established in 1887 and became part of Columbia University in 1898. It granted its first degrees in 1901. See **Teachers College, Columbia University.**

Union Theological Seminary in New York City is affiliated with Columbia University. For musically gifted students, Columbia has joint programs with the Juilliard School, which is also in New York City.

Other facilities. Columbia University operates regional institutes, centers, and programs. These facilities offer graduate studies and conduct research in many fields. These fields include applied social research, cancer research, human nutrition, international change, urban and environmental affairs, and war and peace studies. The Lamont-Doherty Geological Observatory conducts research in oceanography and geological sciences. The Harriman Institute conducts research and offers studies on former Soviet countries.

The university has cooperative programs with many museums, hospitals, libraries, and other institutions in New York City. Columbia's libraries have about 5 $\frac{3}{4}$ million volumes and 59,000 serials. The Butler Library has collections of rare books and historical documents.

History. Columbia was one of the earliest colleges founded in colonial America. King George II of England chartered it as King's College in 1754. It stood for many years near the present site of the city hall of New York City. A medical school was added in 1767, and the buildings were used as a hospital during the Revolutionary War. The school reopened as Columbia College after the war. Columbia moved to a temporary site in midtown New York City in 1857.

Columbia added schools of law and mines, and the faculties of political sciences, philosophy, and pure science. With the founding of the school of architecture in 1896, Columbia became a university. In 1897, the university moved to its present site. Columbia College was open only to men until 1983.

Critically reviewed by Columbia University

See also **Barnard, Frederick A.; Butler, Nicholas M.**

Columbian Order. See **Tammany, Society of.**

Columbine, *KAHL uhm byn,* is the name of a group of flowering plants that occur naturally in Asia, Europe, and North America. These plants grow each year from underground rootstocks and flower from April to July. Bees and hummingbirds are attracted to columbines because the flower petals hold large amounts of nectar. Gardeners plant many kinds of columbines in rock gardens and flower beds.

The *wild columbine* bears red and yellow nodding flowers on the upper part of rigid, slender stems. Each flower has five long-spurred petals and many *stamens* (pollen-producing parts). The *Rocky Mountain columbine,* also called *blue and white columbine,* is the state flower of Colorado. Its large blue and white flowers have petals up to 2 inches (5 centimeters) long. The long spurs on the petals curve outward and are slightly swollen at the tip. The *short-spurred columbine* bears blue or purple flowers. Its short spurs bend inward and end in a hook. Melinda F. Denton

Scientific classification. Columbines belong to the crowfoot family, Ranunculaceae. The scientific name for the wild columbine is *Aquilegia canadensis.* The Rocky Mountain columbine is *A. caerulea.* The short-spurred columbine is *A. brevistyla.*

See also **Flower** (picture: Flowers of woodlands and forests).

Columbite, *kuh LUHM byt,* is a black, dense mineral made up of iron, manganese, niobium, oxygen, and, in some cases, tantalum. It is the chief source of niobium, which is used in some steels. The composition of columbite varies widely, with tantalum taking the place of different amounts of niobium. The chemical formula of tantalum-free columbite is $(Fe,Mn)Nb_2O_6$. A similar mineral that has more tantalum than niobium is called *tantalite.* The crystal structure of columbite is *orthorhombic,* with three sets of unequal rectangular faces (see **Crystal** [Classifying crystals]). Columbite occurs in coarse granitic rocks called *pegmatites.* It is mined in Brazil and several African countries. Robert B. Cook

See also **Niobium; Tantalum.**

Columbium. See **Niobium.**

Columbus, Georgia (pop. 186,291; met. area pop. 274,624), is the state's second-largest city. Only Atlanta has more people. Columbus is an industrial and military center. The city lies on the Chattahoochee River, which forms Georgia's southwestern boundary with Alabama. For the location of Columbus, see **Georgia** (political map).

The city's chief industries include banking, credit card processing, insurance, and the manufacture of textiles and snack foods. Fort Benning, the home of the U.S.

Army Infantry Center, adjoins Columbus to the south.

A 28-block national historic district in downtown Columbus includes many historic homes from the 1800's. The state theater of Georgia, the Springer Opera House, was built in Columbus in 1871. The city is the home of Columbus State University. The National Infantry Museum is at Fort Benning.

In the early 1900's, Columbus industrialist W. C. Bradley helped to develop the soft drink Coca-Cola into an international product. In recent times, the Bradley-Turner Foundation, supported by profits from Coca-Cola stock, has funded the Columbus Museum of Arts and Sciences, the National Confederate Naval Museum, the Coca-Cola Space Science Museum and many other cultural institutions and activities in the city.

Creek, or Muskogee, Indians lived in what is now the Columbus area before white settlers arrived. Two major Creek towns, Coweta and Cusseta, were early trading centers for the English, Spanish, and French. Columbus was founded as a planned community in 1828 at the northernmost navigable point of the Chattahoochee River. The river powered the city's cotton mills, the first of which opened in 1838. Textile manufacturing dominated the city's economy into the second half of the 1900's.

In 1971, Columbus and Muscogee County were consolidated under a council-manager form of government. Columbus was the first Georgia city to adopt a consolidated city-county government. Virginia E. Causey

Columbus, Ohio, is the capital and largest city of the state. It is a leading research, computer information, and manufacturing center. Columbus lies near the center of Ohio, where the Olentangy and Scioto rivers meet. The city is the home of the main campus of Ohio State University, one of the nation's largest universities.

Almost all of Ohio lies within 150 miles (241 kilometers) of Columbus. In 1812, the state legislature chose the site for the capital because it could be reached easily from all major Ohio cities. Many state leaders wanted to name it Ohio City. But General Joseph Foos, a legislator from Franklin County, suggested *Columbus* to honor the explorer Christopher Columbus.

The city covers 190 square miles (492 square kilometers) and is the seat of Franklin County. Columbus has about 25 suburbs. The Columbus metropolitan area consists of 3,142 square miles (8,138 square kilometers) in Delaware, Fairfield, Franklin, Licking, Madison, and Pickaway counties.

The limestone State Capitol stands in Capitol Square, a 10-acre (4-hectare) park at the intersection of the city's main avenues, High and Broad streets. For a picture of the Capitol, see **Ohio** (Ohio in brief).

A group of buildings known as the civic center cover four blocks on both shores of the Scioto River. The buildings on the west shore include the Veterans Memorial Auditorium and Exhibition Hall. Columbus's tallest building, the State Office Tower, rises 624 feet (190 meters) on the east shore. Other east shore structures include federal and state office buildings, police headquarters, LeVeque Tower, and City Hall. A bronze statue of Christopher Columbus stands 20 feet (6 meters) high in City Hall Plaza. The city received the statue from the citizens of Genoa, Italy, the explorer's birthplace. The Avenue of Flags runs two blocks south from City Hall Plaza. It features a display of the 50 state flags.

The Ohio state fairgrounds and Ohio State University are on the north side of Columbus. German Village, a restored German settlement of the mid-1800's, covers 233 acres (94 hectares) just south of downtown.

People. Non-Hispanic whites make up about 67 percent of Columbus's population. This group is composed mainly of people of English, German, and Italian descent. African Americans make up about 24 percent of

Larry Hamill

Columbus is the capital and largest city of Ohio. Tall, modern buildings line the banks of the Scioto River in downtown Columbus, *shown here.* The city lies at the junction of the Scioto and Olentangy rivers.

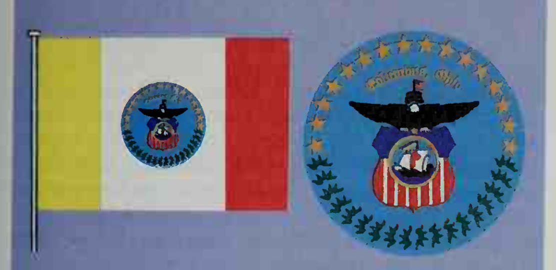
Facts in brief

Population: *City*—711,470. *Metropolitan area*—1,540,157.
Area: *City*—190 mi² (492 km²). *Metropolitan area*—3,142 mi² (8,138 km²), excluding inland water.
Altitude: 777 ft (237 m) above sea level.
Climate: *Average temperature*—January, 30 °F (−1 °C); July, 75 °F (24 °C). *Average annual precipitation* (rainfall, melted snow, and other forms of moisture)—37 in (94 cm).
Government: Mayor-council. *Terms*—4 years for the mayor and 4 years for the 7 council members.
Founded: 1812. Incorporated as a city in 1834.

Largest communities in the Columbus area

Name	Population	Name	Population
Columbus	711,470	Gahanna	32,636
Newark	46,279	Reynoldsburg	32,064
Lancaster	35,335	Dublin	31,392
Westerville	35,318	Grove City	27,075
Upper Arlington	33,686	Delaware	25,243

Source: 2000 census.



Symbols of Columbus. The city flag, *left,* features the city seal in its center. The city is named after Christopher Columbus, and the seal, *right,* shows one of his ships.

the population. Columbus also has a growing population of people of Asian ancestry.

Church groups, such as the Metropolitan Area Church Board (MACB), have helped the city fight against racial problems, juvenile delinquency, and poverty. More than 600 Christian congregations are represented in the MACB. Many non-Christian congregations also work with the group. Another group, the Columbus Metropolitan Area Community Action Organization, helps manage federal, city, and state welfare programs.

In 1960, Columbus became the nation's first city to build apartment projects for the aged that included special recreational facilities. The city also maintains other recreation centers for elderly citizens.

Economy of Columbus is well balanced. About a fourth of the city's workers are employed in retail or wholesale stores. Government agencies and manufacturing firms each employ about a fifth of the labor force. Almost a fifth hold jobs in education, health, and other service industries. Columbus is headquarters for several computer information services. The Chemical Abstracts Service is the world's largest computer-based chemical information service. The Online Computer Library Center provides computer information services for libraries and other institutions.

Research firms located in the city include the Battelle Memorial Institute, which conducts scientific research for private industry and the government (see **Battelle Memorial Institute**). The institute operates one of the largest private research laboratories in the world.

Manufacturers in Columbus produce airplanes and automobile parts, cement mixers, coal-mining equipment, electric appliances, foundry and machine shop materials, and telephone equipment. Other industries in the city include printing and publishing. Columbus has one daily newspaper, *The Columbus Dispatch.*

Railroads and truck lines provide freight service to the city. Airlines use Port Columbus International Airport.

During the 1950's, new suburban shopping centers, restaurants, and theaters began to take business away from downtown Columbus. Construction of office buildings, motels, and an underground parking garage in the early 1960's attracted many people to the city during the day. But night life continued to suffer, and several theaters and restaurants closed. The reopening of two theaters and the opening of Ohio Center (now called the Greater Columbus Convention Center) brought more people back into the downtown area during the 1980's. The Columbus City Center, a large downtown shopping mall that opened in 1989, has also brought new life and commerce to the core of the city.

Education. Columbus pioneered education. In 1837, the city began the nation's first state-operated school for the blind. The first junior high school in the United States opened in Columbus in 1909. And in 1922, Ohio State University founded radio station WOSU, the first educational radio station in North America.

Today, about 67,000 children attend about 130 public elementary and high schools and special schools in Columbus. About half of the students are black. Almost 12,000 students attend the city's 43 private and church-supported schools. The Columbus Board of Education has made special efforts to involve the community in its work. The board sponsors radio and television shows, holds neighborhood meetings, and publishes reports on the city's schools and their students and staff.

Ohio State University is the largest university in Ohio. Other institutions of higher learning in Columbus include Capital University, Columbus College of Art and Design, Franklin University, Mount Carmel College of Nursing, Ohio Dominican College, and Pontifical College Josephinum, the only seminary in the Western Hemisphere that is directly subject to the Vatican. Three other seminaries, three colleges, two business schools, and a technical institute are also in the Columbus metropolitan area. The Columbus Public Library has a main library and several branch libraries.

Cultural life and recreation. The Columbus Symphony Orchestra and the city's ballet company perform at the Ohio Theatre. Opera/Columbus and Broadway touring shows are presented at the Palace Theatre.

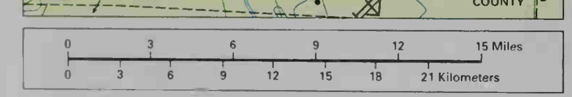
The Columbus Museum of Art has an outdoor sculpture park and garden featuring American and European sculpture of the 1800's and 1900's. The exhibit presents the works of such artists as Alexander Calder, Aristide Maillol, and Henry Moore. The city's Center of Science and Industry includes a planetarium. The Ohio Historical Center has exhibits of Indian life in early Ohio.

The Greater Columbus Arts Festival, held each June

Columbus

Columbus, Ohio's capital and largest city, lies in the central part of the state. It is also a major education and research center. The larger map shows points of interest in the Columbus area.





on the downtown riverfront, features displays of architecture and painting, and performances of dance and drama. The state fair is held annually in August. It includes agricultural exhibits and entertainment, and provides a showplace for Ohio artists.

Columbus has over 200 parks and playgrounds. The metropolitan area includes 11 other parks. The Park of Roses displays about 36,000 rose plants. The Columbus Zoological Gardens features baby farm animals that youngsters may feed and pet. The zoo is known for its ape collection. The first gorilla born in captivity was born in the zoo in 1956. The Columbus Blue Jackets play in the National Hockey League.

Government. Columbus has a mayor-council form of government. The voters elect the mayor and seven council members to four-year terms. A city income tax provides Columbus with about half its revenue.

During the 1960's, the lack of good public transportation became an important problem in the Columbus area. In 1971, the governments of Franklin County and Columbus and nearby cities created the Central Ohio Transit Authority to deal with this problem. The agency purchased Columbus's privately owned bus company.

History. The Delaware and Wyandot Indians lived in what is now the Columbus area before white settlers first arrived. In 1797, settlers founded Franklinton, the first city in the area, on the west side of the Scioto River. The Ohio legislature established Columbus on the east bank, opposite Franklinton, in 1812. Within a year, Columbus had about 300 people. They included many Germans, and Germans continued to settle on the south side of the city throughout the 1800's. In 1816, the Ohio legislature moved to Columbus from Chillicothe, the temporary state capital. By that year, the city's population had grown to about 700.

During the 1830's, Columbus developed as a transportation and trade center. In 1831, a canal connecting Columbus with the Ohio and Erie Canal opened the way to increased trade with Eastern cities. The National Road, one of the principal pioneer routes to the West, reached Columbus in 1833. The city had about 3,500 people when it was incorporated in 1834.

The arrival of the railroad in the middle 1800's brought more commerce to Columbus. When the American Civil War began in 1861, the city had a population of 18,629. During the war, Columbus became the assembly point for Ohio troops and the site of the largest Northern prison for Confederate soldiers. In 1871, Columbus annexed most of Franklinton across the river. By 1900, the city's population had grown to 125,500, and buggy manufacturing had made Columbus the industrial leader of central Ohio.

In 1913, nearly 100 people died when the Scioto River flooded Columbus. After this flood, the greatest disaster in the city's history, Columbus began a waterfront renewal project. The city built flood walls, bridges, and the beginning of the civic center.

Columbus continued growing during the 1900's. The city's population jumped from 290,500 in 1930 to about 565,000 in 1980. Maynard E. Sensenbrenner, who served as mayor of Columbus during most of the 1950's, 1960's, and early 1970's, developed a policy of annexing an average of 6 $\frac{1}{2}$ square miles (17 square kilometers) of unincorporated land around the city each year.

During the 1960's, an urban renewal program led to the rebuilding of the south side's German Village, which had been in poor condition since the early 1900's. Several old buildings also were rebuilt or replaced as part of downtown renewal projects. New construction included seven office buildings, two high-rise apartment buildings, and three motels. A 41-story state office building was completed in 1975.

Ohio Center, a downtown convention center, opened in 1980. An addition to the Ohio Center was completed in 1993. The center, with this addition, was renamed the Greater Columbus Convention Center. Construction of the Columbus City Center was completed in 1989. This shopping mall, which is located south of the State Capitol, includes more than 100 stores. It is connected to office buildings and a hotel. The 2000 U.S. census listed Columbus as Ohio's largest city, with a population of about 711,000.

Mark A. Ellis

Christopher Columbus

1451-1506



Signature



SCALA/Art Resource
Coat of arms



Christopher Columbus has been depicted by many artists over the years. The woodcut at the right is based on a lost painting that dates from 1550. It is considered one of the most accurate likenesses of the explorer. Columbus had a distinctive signature, *above left,* and coat of arms, *above right.*

Woodcut (1575) by Tobias Stimmer; frontispiece in *The Columbus Gallery* by Néstor Ponce de León, 1893

Columbus, Christopher (1451-1506), was an outstanding navigator and organizer of expeditions. He achieved fame by sailing west across the Atlantic Ocean in search of a sea route to Asia. But he did not accomplish this goal. Instead, he encountered islands in the Caribbean Sea. At that time, the people of Europe and the Americas did not know of each other's existence. During his four voyages westward—between 1492 and 1504—Columbus explored what are now the West Indies and the coasts of Central and South America.

Columbus was not the first European to reach the Western Hemisphere. The Norse (also called the Vikings) had settled for a time on the coast of North America about A.D. 1000. But that contact did not last, and most Europeans of the 1400's did not know it had taken place. Columbus' voyages led to enduring links between the Eastern and Western hemispheres.

The world of Columbus

The Europe into which Columbus was born in 1451 was struggling against the growing power of the Ottoman Turks, who had conquered much of southeastern Europe. In 1453, the Ottomans took control of Constantinople (now Istanbul, Turkey), a major center of trade between Europe and Asia. The Ottomans made Constantinople the capital of their empire, cutting off easy European access to Asian goods. The only alternative to a difficult, dangerous land journey was a sea route—either around Africa or westward across the Atlantic.

The desire for a sea route to Asia launched a remarkable wave of European exploration, despite the fact that Europe had limited resources. For example, the wealth of the countries of Europe could not match the wealth of China, which launched seven mammoth sea expeditions between 1405 and 1433, reaching as far as eastern Africa. However, European explorers combined the seafaring skill of the Italians with the resources of the Portuguese and the Spanish. Europe constantly improved its ships and navigational aids, as well as its arms and firepower. Europeans also had other qualities that encouraged overseas exploration, including a passion for trading and a desire to preach Christianity worldwide.

Early years

Boyhood. The exact date of Columbus' birth is not known. He was born sometime between Aug. 25 and Oct. 31, 1451, in Genoa, then capital of a self-governing area on the northwest coast of Italy. Genoa was an important seaport, and Genoese ships traded throughout the Mediterranean region.

Christopher's given and family name was *Cristoforo Colombo.* In English, he is known as *Christopher Columbus,* the Latinized forms of the name. He called himself *Cristóbal Colón* after he settled in Spain. His father, Domenico Colombo, was a wool weaver. To increase his income, Domenico also worked as a gatekeeper and wine merchant. Christopher's mother, Susanna Fontanarossa, was the daughter of a wool weaver.

Christopher was the oldest of five children. His brothers, Bartholomew and Diego, worked closely with him on many of his enterprises. Christopher and his brothers may have been tutored or sent to a monastery school to learn basic Latin and mathematics. Christopher's formal education ended at about age 14.

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Young adulthood. Christopher's ambitious father pushed the boy into a business career, and Christopher began to sail on trading trips. He worked as an agent for the Spinola, Di Negro, and Centurione families of Genoa. In the mid-1470's, in his first documented voyage, Columbus took part in a trading expedition to the island of Chios, a Genoese possession in the Aegean Sea. In 1476, he settled in a Genoese colony in Lisbon, Portugal. There is a legend that he reached Portugal by swimming ashore clinging to an oar after being attacked by pirates. In Lisbon, Columbus joined with his brother Bartholomew to draw and sell maps.

Columbus frequently attended Mass at a chapel at the Convento dos Santos, a school for aristocratic young women. There, he met Felipa Perestrello Moniz, whom he married in 1479. Felipa's father was the first governor of Porto Santo, a Portuguese island in the Madeira group off the Atlantic coast of northern Africa. The young couple moved to Porto Santo, and then to the nearby island of Madeira. Their only child—a son, Diego—was born in 1480. Felipa died in 1484 or 1485.

Between 1480 and 1482, Columbus made voyages to the Canary Islands and the Azores, island groups in the Atlantic Ocean west of Africa. Columbus also visited Portugal's fortified trading posts in western Africa, where he observed the trade in gold and slaves. Some historians believe Columbus also went to England and Ireland, and even to Iceland, where he may have learned of early Norse explorations.

The plan to sail westward

The basis of the plan. By the 1480's, the Portuguese had invented the *caravel,* a sturdy ship that could sail against the wind. They were trying to reach the Indies—what are now India, China, the East Indies, and Japan—by sailing around Africa. By doing this, they hoped to gain direct access to gold, silk, gems, and spices. The cloves, nutmeg, and mace of the Spice Islands (now the Moluccas of Indonesia) served as medicines as well as seasonings. These valuable items had been transported to Europe by means of dangerous and costly overland caravans that were often hindered by Ottoman officials. While Portuguese sailors were trying to reach Asia by sailing around Africa, Columbus thought of what he believed to be the easy way—sailing due west.

Many people in the 1400's relied on a map of the world designed by Ptolemy, an astronomer and geographer in Alexandria, Egypt, during the A.D. 100's. Ptolemy's map showed most of the world as covered by land. Columbus found further confirmation for his idea of sailing west to Asia in the letters of Paolo Toscanelli, an influential scholar from the Italian city of Florence. Toscanelli believed that China lay only 5,000 nautical miles (9,300 kilometers) west of the Canary Islands. Columbus planned to sail 2,400 nautical miles (4,500 kilometers) west along the *latitude* (distance from the equator) of the Canaries until he reached islands near Japan. There, he hoped to establish a trading town.

Columbus' plan was based in part on two major miscalculations. First, he underestimated the circumference of the world by about 25 per cent. Columbus also mistakenly believed that most of the world consisted of land rather than water. This mistake led him to conclude that Asia extended much farther east than it actually did.

Presentation of the plan to Portugal. About 1483, Columbus gained audiences with King John II of Portugal. The king placed Columbus' proposal before his council, which rejected it. Columbus did not have to prove to the council that the world was round because educated people at that time knew it was. The council turned down his plan on the belief that he had greatly underestimated the length of the journey. The king's advisers thought that Portugal's resources should be invested in finding a route around Africa to Asia.

Years of waiting. In 1485, Columbus and his son went to Spain, a bitter rival of Portugal. At that time, Spain consisted of the united kingdoms of Castile and Aragon. Columbus arrived during Spain's war to drive the Muslims out of Granada, the only remaining Islamic kingdom on Spanish soil. Two wealthy Spanish aristocrats offered to give Columbus some ships. But to do so, they needed the permission of Spain's King Ferdinand and Queen Isabella. In 1486, Columbus gained an interview with the monarchs, but they were in no position to finance an expedition. They were also cautious about reopening conflict with Portugal. Spain and Portugal had recently settled their disputes over various islands off Africa. The Treaty of Alcaçovas, signed in 1479, had conceded the Canary Islands to Spain and the Madeira and Cape Verde islands and the Azores to Portugal.

However, the intensely religious monarchs were interested in how Columbus vowed to use the proceeds from his expedition. He promised to use the money to recapture Jerusalem from the Muslims. There, he said, he would rebuild the Jews' holy Temple and bring on a new "Age of the Holy Spirit." His eloquent arguments gained him support among Franciscan friars and Jews, including Jews who had converted to Christianity.

Queen Isabella was about the same age as Columbus, and she admired men of conviction. At her insistence, Columbus' plan was put before a commission of experts. They met in the Spanish cities of Salamanca and Córdoba during 1486 and 1487 under the leadership of Isabella's spiritual adviser, Hernando de Talavera. Although the committee's first report rejected Columbus' plan, Isabella granted him a small salary.

During this period, Columbus lived with a woman named Beatriz Enríquez de Harana. She gave birth to his second son, Ferdinand, in 1488.

For the next several years, Columbus followed the Spanish court as it traveled through the country. In 1490, the experts issued a final report. They scoffed at his plan—not because they thought that the world was flat or sea monsters would devour the ships, but because they still believed his estimates were wrong. The committee favored the belief that the world was large and covered mostly by water rather than small and composed mostly of land. In addition, Columbus' demands had increased. He wanted to become a titled aristocrat, to rule the lands he discovered, and to be able to pass these privileges on to his sons. He also wanted a percentage of the wealth he brought back to Spain.

Success in Spain. Columbus refused to give up. He sent his brother Bartholomew to seek support from the English and French courts, but the attempts were unsuccessful. Columbus' chance finally came when Spain conquered Granada in January 1492. In the aftermath of this victory, Luis de Santangel, a royal treasurer, convinced



Columbus's three ships from his first voyage westward were re-created to commemorate the 500th anniversary of his landing. Leading the procession is the reconstructed *Niña,* followed by the *Pinta* and the *Santa María.*

Spain '92 Foundation

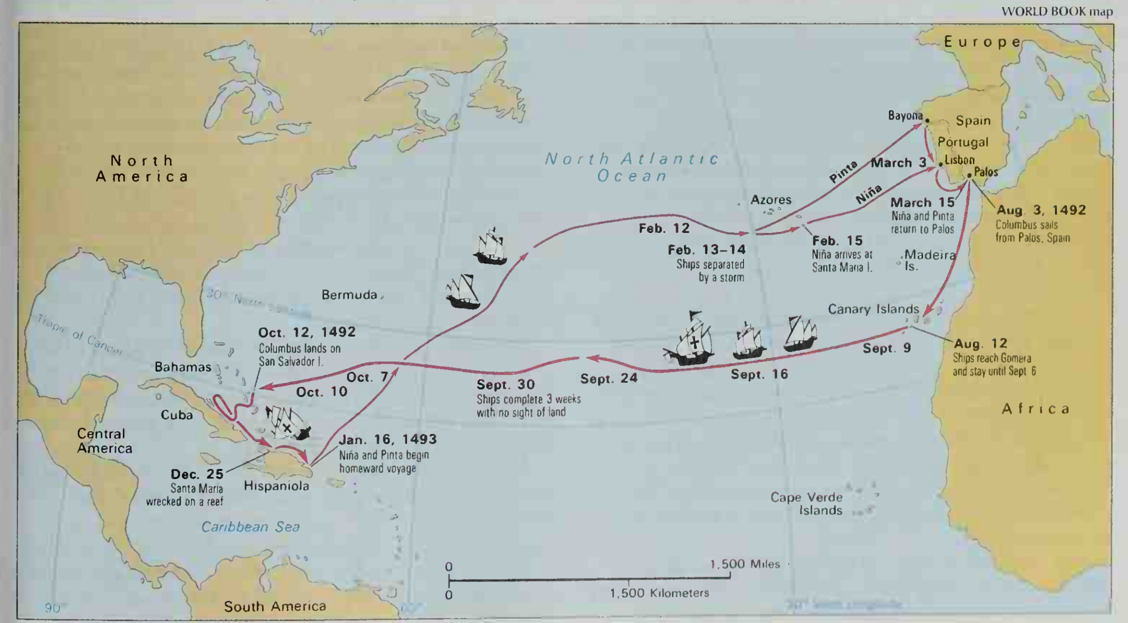
Isabella that she was missing a great opportunity. Thus, in April 1492, Columbus's plan suddenly received royal approval. There is no truth to the story that Isabella offered to pawn her jewels to pay for the voyage. Columbus's supporters—including Santangel, who ran a government agency that had extra money in its treasury—provided the funds for the expedition.

First voyage westward

Ships and crews. Palos, a small port in southwestern Spain, was home to the Pinzón and Niño families. They provided two of the ships and selected the crews for Columbus's first voyage. Martín Alonso Pinzón, an experienced seafarer, captained the *Pinta,* a caravel with square-rigged sails that could carry about 60 tons (54 metric tons). His brother Vicente Yañez Pinzón captained the slightly smaller *Niña,* a caravel with *lateen* (triangular) sails. Columbus captained the third vessel, the *Santa María.* It was chartered from Juan de la Cosa, who came along as sailing master. It was slightly bigger than the other two ships. All three were made of wood, had no engines or motors, and provided few comforts.

Columbus's first voyage westward On Aug. 3, 1492, Columbus sailed from Spain in search of a route to the Indies across the Atlantic Ocean. On October 12, he reached an island that he called San Salvador. For many years, historians believed that Columbus's first landing took place on present-day San Salvador, shown on this map. But today, scholars do not agree on the exact site of this landing.

WORLD BOOK map





Detail of *Landing of Columbus* (1844) by John Vanderlyn; U.S. Capitol Rotunda (U.S. Capitol Historical Society)

Columbus first landed in the West Indies on Oct. 12, 1492. The painting above is how an artist of the 1800's imagined Columbus claimed the island for Spain. The woodcut at the right, which appeared in the first printed version of a letter Columbus sent to Spain in 1493, shows him trading with the Indians.



New York Public Library

A total of about 90 crew members sailed aboard the three ships. In addition to the officers and sailors, the expedition included a translator, three physicians, servants for each captain, a secretary, and an accountant.

Aboard ship, there was endless work to be done handling the sails and ropes and pumping out water that seeped or washed aboard. Cleaning and repair work filled the remaining hours. The crews cooked on portable wood-burning stoves. Their main meal consisted of a stew of salted meat or fish, hard biscuits, and watered wine. The sailors had no sleeping quarters, so they huddled on deck in good weather or found a spot below deck during storms. Only a few officers had bunks.

Sailing west. The fleet set out from Palos on Aug. 3, 1492, and sailed to the Canary Islands, a possession of Spain off the coast of Africa. Repairs were made on the island of Grand Canary, and the crews loaded provisions on the island of Gomera. The ships left Gomera on September 6. Because he had journeyed south before sailing west, Columbus could take advantage of the trade winds. At that latitude, these winds always blow from the northeast.

Columbus had few navigational instruments. He knew enough about celestial navigation to measure latitude by using the North Star. However, he had no instruments for determining the ship's position from the stars except a crude quadrant that was not accurate when the ship rolled. He used a compass to plot his course, estimated distances on a chart, relied on a half-hour glass to measure time, and guessed his speed. Together, these activities make up a method of navigation known as *dead reckoning.*

After a month of smooth sailing, the crews became anxious that they had not yet reached the islands Columbus had led them to expect. There was no full-fledged mutiny, but only the authority of the Pinzón brothers enabled Columbus to quiet the crews' loudly expressed doubts. Then, signs of approaching land began to appear, such as coastal seaweed on the surface of the water and land-based birds flying overhead.

Between the evening of October 11 and the morning of October 12, a sailor on the *Pinta* named Juan Rodríguez Bermejo called out, "Land, land!" Isabella had offered a reward to the first person to sight land. However, Columbus said that he had seen a flickering light hours earlier, and he claimed the reward.

The first landing. Before noon on October 12, the ships landed on an island in the Caribbean Sea, in what are now called the West Indies. Columbus named the island *San Salvador* (Spanish for *Holy Savior*). He later learned that inhabitants of the area called the island Guanahaní. However, historians are not sure which island this is. In 1926, Watling Island in the Bahamas was officially renamed San Salvador Island because Columbus scholars considered it the most likely landing site. Other islands where he might have landed include Samana Cay and Conception in the Bahamas, and Grand Turk in the Turks Islands.

Columbus believed he had arrived at an island of the East Indies, near Japan or China. Because of this belief, he called the islanders *Indians.* People realized within 30 years that Columbus had not reached the Indies, but the name *Indian* continued to be used.

The islanders were probably the Taíno, a subgroup of the Arawak people. They were skilled farmers who made cotton cloth, grouped their dwellings into villages, and had well-developed social and governmental systems. Columbus described them as gentle, "primitive" natives living in an island paradise. This description set the pattern for European attitudes toward the Western

Hemisphere, despite later knowledge of the highly advanced Aztec of Mexico and Inca of Peru. In his writings, Columbus referred to the partial nudity of the Taíno. To the Europeans, this lack of clothing meant the Indians were not "civilized," even though it was appropriate to the warm climate.

On October 28, the fleet entered the Bay of Bariay off Cuba. Thinking they were near the Asian mainland, the captains explored harbor after harbor. They then sailed along the northern coast of the island of Hispaniola, now divided between the Dominican Republic and Haiti. Columbus called it *La Isla Española* (the Spanish Island).

The night of December 24, an exhausted Columbus gave the wheel of the *Santa María* to a sailor, who passed it to a cabin boy. The ship crashed and split apart on a reef near Cap-Haïtien, in present-day Haiti. Aided by a local chief, the crew built a makeshift fort. Columbus left about 40 men there to hunt for gold. He then started home on the *Niña,* sailing from Samaná Bay on the northeast coast of Hispaniola on Jan. 16, 1493. He brought several captured Taínos with him. Martín Pinzón captained the *Pinta.*

Return to Spain. The homeward voyage was rough and difficult. Some of the Taínos died. After about a month of travel, the *Niña* and the *Pinta* became separated during a storm. The *Niña* came ashore on the Portuguese island of Santa Maria in the Azores. Columbus and his crew were almost arrested by the governor, who assumed they had been trading illegally in Africa. Columbus set out again, but storms forced him to seek shelter in Lisbon. The *Niña* finally reached Palos on March 15, 1493.

Columbus had been concerned that Martín Pinzón would reach Spain first and claim the glory. Indeed, Pinzón had reached a small village in Spain a few days earlier and had notified the monarchs of his arrival. However, they refused to see him until they had heard from Columbus. The *Pinta* arrived at Palos a few hours after the *Niña.*



The Return of Christopher Columbus from the New World (1839), an oil painting on canvas by Eugène Delacroix; The Toledo Museum of Art, Toledo, Ohio, "Gift of Thomas A. DeVilbiss Bequest Fund"

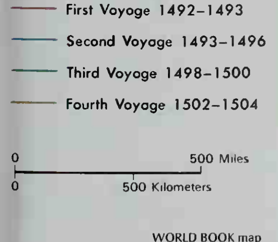
Columbus returned to Spain on March 15, 1493. He later reported his findings to King Ferdinand and Queen Isabella, *above.* They gave him the titles *Admiral of the Ocean Sea* and *Viceroy of the Indies* and ordered a second voyage.

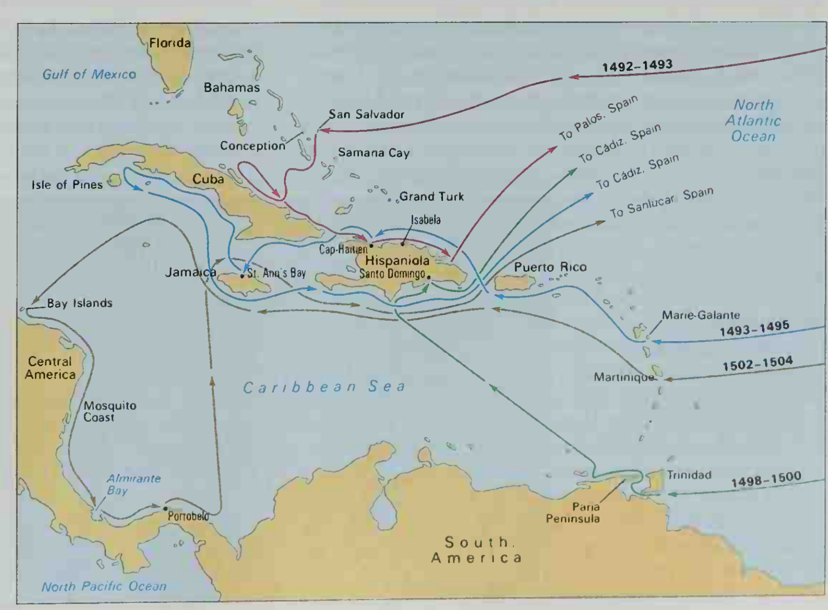
Columbus reported to Ferdinand and Isabella at Barcelona, Spain, where they gave him a grand reception. Columbus had little to show except some gold trinkets and the few Taínos who survived the harsh trip, but the monarchs determined to exploit his find. They quickly applied to Pope Alexander VI for control over the lands visited so far, and also of all lands west of a line 100 leagues (about 300 nautical miles, or 560 kilometers) from the Azores. The pope granted Ferdinand and Isabella the right to preach the Christian faith in the islands, and they used this right as the basis for sweeping claims over the lands. However, Portugal complained that these terms violated an earlier treaty.

In 1494, negotiations opened in the town of Tordesillas in Spain. Spain and Portugal eventually agreed to move the line to 370 leagues (about 1,100 nautical miles,

Columbus' voyages of exploration

Columbus made four voyages westward between 1492 and 1504. He explored the coasts of Cuba, Hispaniola, Jamaica, and Puerto Rico on the first and second voyages. Columbus reached the mainland of South America on the third and fourth voyages.





WORLD BOOK map

or 2,060 kilometers) west of the Cape Verde Islands. This later enabled Portugal to claim Brazil and the Newfoundland Banks. See Line of Demarcation.

Second voyage westward

Return to the islands. Columbus was put in charge of 17 ships for a second voyage. The all-volunteer crew of about 1,200 to 1,500 men included colonists who intended to settle in the islands. Most dreamed of quick wealth and a rapid return home. Priests went along to try to convert the Indians to Christianity.

The fleet sailed from Cádiz, Spain, on Sept. 25, 1493. It took on supplies in the Canaries and completed the ocean crossing in a speedy 21 days. In another three weeks, the ships reached Hispaniola. They passed many islands. Columbus named one of them—present-day Marie-Galante in the French West Indies—after his flagship. Columbus also landed briefly at Puerto Rico, the only part of what is now the United States that he visited.

Trouble, settlement, and exploration. In Hispaniola, Columbus searched in vain for the sailors he had left at the fort. No one discovered exactly what had happened, but apparently the crew had fought among themselves about local women. The survivors had probably been killed by the Taínos, whom they had mistreated.

Columbus moved eastward along the north coast of Hispaniola and established Isabela, a fortified post. There, the Spanish colonists quickly saw that the riches promised by Columbus would not materialize. They resented being given orders by a Genoan rather than a Spaniard, and some fell ill from tropical fevers. Shortly after their arrival, 12 of the 17 ships returned to Spain with orders to bring more supplies to Isabela. The ships also carried discontented colonists back to Spain. To prevent rebellion, and also to make the voyage produce a quick profit, Columbus sent some men into the interior of Hispaniola to search for a gold mine.

Leaving his brother Diego in charge, Columbus left Isabela during the spring of 1494 to explore the southern coast of Cuba (which he called *Juana*). After traveling down its long coastline, Columbus declared that it was the Asian mainland. Although this was not so, he forced the crews to sign an affidavit saying they agreed with him. Columbus also landed at Jamaica.

When Columbus returned to Hispaniola, he found his brother Bartholomew waiting for him. Columbus immediately appointed Bartholomew provincial governor of Hispaniola. This appointment angered many of the Spanish settlers. In addition, they complained about having only *cassava* (tapioca), corn, fish, and yams to eat.

The brothers also had to quiet the Indians, who were no longer peaceful after the Europeans treated them harshly. In addition, the Taínos had begun to suffer and die from infectious diseases brought over unintentionally by the Europeans, and food had become scarce. Columbus forced all male Taínos over age 14 to pan rivers for gold. Those who failed to collect an assigned quota of gold were punished, sometimes by having their hands cut off. The quotas were almost impossible to meet. When the Indians threatened to rebel, Columbus used their rebellion to justify enslaving them.

In Spain, the priests and Spanish colonists who had left Isabela in the early months of 1494 complained to Ferdinand and Isabella about conditions in Hispaniola. The priests criticized the maltreatment of the Taínos, and the colonists charged Columbus with misgovernment in the colony. Columbus decided to return to Spain to defend himself, arriving in June 1496. Again, Columbus' powerful oratory and impressive presence succeeded. The king and queen reconfirmed his titles and privileges, and they granted his request for additional men, supplies, and ships. But few men wanted to sail with him this time because the islands had failed to yield the expected profit. To assemble crews, Ferdinand and Isabella had to pardon prisoners. So low had Columbus' reputation sunk that his sons, who served as pages at court, were mocked by other boys. They jeered, "There go the sons of the Admiral of the Mosquitoes."

Third voyage westward

Third journey to the west. On May 30, 1498, Columbus departed from Sanlúcar, Spain, with six ships. He charted a southerly course. Ferdinand and Isabella wanted Columbus to investigate the possibility that a mainland lay south or southwest of the lands he had already explored. The possibility that such a mainland existed had been accepted by the king of Portugal, and Spain wanted to stake its claim.

The fleet ran into a windless region of the ocean and was becalmed in intense heat for eight days. It reached an island Columbus called *Trinidad* (meaning *Trinity*) on July 31 and then crossed the Gulf of Paria to the coast of Venezuela. Columbus observed an enormous outflow of fresh water—later found to come from the Orinoco River—that made him realize this land could not be an island. He wrote in his journal: "I believe that this is a very great continent which until today has been unknown." Columbus imagined that the great rush of fresh water must be a river flowing from the Garden of Eden.

Some scholars believe that while in Spain, Columbus had heard of English-sponsored landings in Nova Scotia and Newfoundland in 1497 by Italian explorer John Cabot. The news may have made Columbus think he might not have reached Asia. He did not mention his doubts, wanting to first explore and claim the land for Spain. For this reason, instead of being named for Columbus, the American continents were named after Amerigo Vespucci, an Italian navigator. A few years later, in a document backdated to 1497, the claim was made that Vespucci had been the first to explore the mainland, believing he had reached a "New World."

Problems in Hispaniola. Columbus found the Hispaniola colony seething with discontent. He tried to quiet the settlers by giving them land and letting them enslave the Indians to work it, but that failed to satisfy many. A rebellion had been led by the chief justice, Francisco Roldán. For a time, Roldán and the Taínos—with whom he had established an alliance—held part of the island. Columbus managed to subdue the rebellion through negotiation and a show of force.

Columbus in disgrace. By 1500, many complaints about Columbus had reached the Spanish court. Ferdinand and Isabella sent a commissioner named Francisco de Bobadilla to investigate. Upon arrival in Santo Domingo—the capital of Hispaniola—in August 1500, Bobadilla was shocked by the sight of several Spanish rebels

swinging from gallows. He freed the remaining prisoners, arrested Columbus and his brothers, put them in chains, and sent them to Spain for trial. Once at sea, the captain of Columbus' ship offered to unchain him. But Columbus refused, saying he would only allow the chains to be removed by royal command.

In Spain, Columbus and his brothers were released by order of the king and queen. The rulers forgave Columbus, but with conditions. Columbus was allowed to keep his titles, but he would no longer be permitted to govern Hispaniola. Nicolás de Ovando was sent to serve as governor of Hispaniola, with about 30 ships carrying 2,500 colonists.

Fourth voyage westward

The final voyage. Columbus planned still another journey, which he called the "High Voyage." He saw it as his last chance to fulfill the promise of his earlier expeditions. His goal was to find a passage to the mainland of Asia. Columbus still believed that China lay close by. Ferdinand and Isabella granted his request for ships because they wanted to get him out of the way. But they instructed him not to stop at Hispaniola unless absolutely necessary to get supplies, and then only in preparation for his return to Spain.

On May 9, 1502, Columbus set sail from Cádiz, Spain, with four ships. Columbus' son Ferdinand, about 14 years old, sailed with his father. Ferdinand's account of the trip, though written many years later, remains the best record of the voyage. The fleet stopped briefly at the Canary Islands, then sailed to Martinique—in what is now the French West Indies—in just 21 days. It then headed toward Hispaniola.

A dangerous hurricane. Governor Ovando was sending 21 ships to Spain when he received a message from Columbus warning of an impending storm and asking permission to land. Feeling contempt for Columbus, and reminding him that he was forbidden to land at Hispaniola, Ovando ignored the warning and sent his ships to sea. Columbus' fleet weathered the storm. However, all but one of Ovando's ships sank in a hurricane. Columbus' enemies Bobadilla and Roldán drowned. The ship that reached Spain was the one carrying Columbus' share of the gold collected in Hispaniola, and the personal possessions he had left there.

Further explorations. At the end of July, Columbus and his fleet reached the coast of Honduras. For the rest of the year, they sailed east and south along the coasts of what are now Honduras, Nicaragua, Costa Rica, and Panama. The ships were battered by rough winds and driving rains.

At the narrowest part of the Isthmus of Panama, Columbus heard tales that a large body of water lay a few days' march across the mountains. But he did not follow up on this information, so he missed a chance to become the first European to see the Pacific Ocean. Columbus abandoned his search for a passage to Asia on April 16, 1503. He was exhausted and suffering from malaria, which made him delirious.

The hard journey home. Columbus' fleet had to move slowly, because his ships were leaking badly from holes eaten in the planking by shellfish. On June 25, the two remaining ships had to be beached at St. Ann's Bay, which Columbus had called Santa Gloria, on the northern coast of Jamaica.

Columbus realized that the chances were slim that another expedition would arrive to rescue him and his crew. Captain Diego Mendez volunteered to try to get help by paddling to Hispaniola in an Indian dugout canoe. Mendez reached Hispaniola, but Ovando refused to provide a ship until more vessels arrived from Spain.

The crews had no tools to repair the ships or to build new ones, and they made no effort to feed themselves. Instead, they relied on the islanders to provide food. The Jamaicans started avoiding them. Columbus later claimed that he used information from an almanac to predict a total eclipse of the moon, which so impressed the islanders that they resumed providing food.

At last, at the end of June in 1504—after being marooned for a year—Columbus and the 100 surviving crew members sailed from Jamaica on a ship chartered by Mendez. They reached Sanlúcar, Spain, on Nov. 7, 1504.

Final days

Queen Isabella died just a few weeks after Columbus returned to Spain. King Ferdinand granted Columbus an audience and listened to his requests. However, Ferdinand tried to persuade Columbus to trade in the rewards and privileges due him in exchange for an estate

Oil painting on canvas (about 1880) by Lorenzo Delleani; Galleria d'Arte Moderna, Genoa, Italy (SCALA/Art Resource)



A chained Columbus was sent back to Spain in 1500. The ship's captain offered to free him, but Columbus refused, saying he would only allow the chains to be removed by royal command.

in north-central Spain. Columbus, in turn, tried to persuade Ferdinand to restore his authority and increase his income, but these requests were not granted.

Columbus spent his last days in a modest house in Valladolid, Spain, suffering from a disease that may have been Reiter's syndrome. On May 20, 1506, Columbus died. Many people believed Columbus was poor at the time of his death, but he actually died wealthy.

Columbus' remains were transported to Seville, Spain, and later to Santo Domingo, in what is now the Dominican Republic. Some historians believe that his bones were moved to Havana, Cuba, in 1795, and, finally, back to Seville in 1899. Other historians believe that the bones of one of Columbus' brothers or of his son Diego were removed from Santo Domingo instead, and that Columbus' final resting place is Santo Domingo.

Columbus' impact on history

Christopher Columbus had a strong will and stuck with his beliefs. His single-minded search for a westward route to Asia changed Europeans' commonly accepted views of the world and led to the establishment of contact between Europe and the Americas.

Many exchanges took place between the Eastern and Western hemispheres as a result of Columbus' voyages. The Europeans grew important cash crops—cotton, rubber, and sugar cane—in the Americas. They established vast plantations worked by Indians and by imported African slaves. They also obtained furs and precious metals. These valuable resources created fortunes for the Dutch, English, French, Portuguese, Russians, and Spanish. The wealth and human resources of the Western Hemisphere gave these countries a huge advantage over the rest of the world in later centuries.

Europeans brought many deadly diseases to America. The previous separation of the Native American peoples from those of Europe and Asia meant that the Native Americans had no resistance to these diseases. As a result, malaria, measles, smallpox, tetanus, typhus, and other infectious diseases swept through the newly exposed populations, killing vast numbers of people. In turn, some Europeans became infected by a form of syphilis unknown in Europe.

The love of freedom and the sharing of leadership among the Native American populations inspired a new belief in personal liberty among Europeans. This belief became a basis for democratic revolutions against European monarchies and greatly influenced the structure of government in the United States.

The Americas also provided many foods that became popular throughout the world. These foods included cassava, cayenne, chocolate, hot peppers, paprika, peanuts, sweet potatoes, tomatoes, and white potatoes. Europe and Asia, in exchange, supplied the Americas with cattle, goats, honey bees, horses, pigs, rice, sheep, wheat, and many trees and other plants.

Recent research into the life and times of Christopher Columbus has somewhat diminished his heroic image as an isolated visionary by placing him in the context of a broad wave of exploration. Historians continue to praise his persistence, courage, and maritime ability. Critics point to his cruelty to the Indians, his poor administration of Hispaniola, and his role in beginning the heedless exploitation of the natural resources of the Americas. Columbus' explorations ended centuries of mutual ignorance about what lay on either side of the Atlantic Ocean. To him belong both the glory of the encounter and a share of the blame for what followed.

Marvin Lunenfeld

Related articles in *World Book* include:

Caravel
Cattle (History)
Columbus Day
Exploration (The great age of European exploration)
Ferdinand V
Flag (pictures: Flags in United States history)
Haiti (History)
Isabella I
Latin America (European discovery and exploration; map)
Vespucci, Amerigo
Virgin Islands (Exploration)

Outline

Questions

On what two miscalculations did Columbus base his plan to sail westward?
What is the only part of the present-day United States that Columbus visited?
What is *dead reckoning*?
How did the Ottoman take-over of Constantinople in 1453 affect trade between Europe and Asia?
What exchanges took place between the Eastern and Western hemispheres as a result of Columbus' voyages?
What made Columbus realize he might not have reached Asia?
Did Spain restore Columbus' authority after the fourth voyage?
Where might Columbus' first landing in the Western Hemisphere have taken place?
Why did Columbus call the islanders he encountered *Indians*?
What happened to the first settlement at Hispaniola?

Additional resources

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Columbus Day honors Christopher Columbus' first voyage to America in 1492. Columbus Day became a legal federal holiday in the United States in 1971. It is celebrated on the second Monday in October. Before 1971, a number of states celebrated Columbus Day on October 12. Cities and organizations sponsor parades and banquets on Columbus Day.

The first Columbus Day celebration was held in 1792, when New York City celebrated the 300th anniversary of the landing. In 1892, President Benjamin Harrison called upon the people of the United States to celebrate Columbus Day on the 400th anniversary of the event. Columbus Day has been celebrated annually since 1920.

Although the land Columbus reached was not named after him, many monuments honor him. The Republic of Colombia in South America and the District of Columbia in the United States bear his name. So do towns, rivers, streets, and public buildings. The name *Columbia* has also been used as a poetic personification of the United States (see **Columbia**). The Columbus Memorial Library in Washington, D.C., contains about 350,000 volumes on the American republics.

Many Latin-American countries celebrate October 12 as the *Día de la Raza* (Day of the Race). It honors the Spanish heritage of the peoples of Latin America. Celebration ceremonies feature speeches, parades, and colorful fiestas. Jack Santino

Column is a freestanding vertical architectural element. When used for structural purposes, columns are often arranged in rows to permit the thickness of walls to be reduced by supporting weight from above. Some columns, erected for decorative or memorial purposes, stand alone. Columns are constructed of various materials, including wood, stone, brick, metal, and concrete.

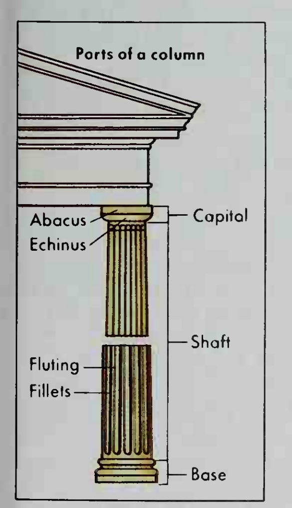
A typical column consists of three parts: base, shaft, and capital. The base is the lowest part of the column. It supports the central upright shaft, which is usually cylindrical. The shaft is crowned by the capital. The horizontal area above the column and supported by it is called the *entablature*. The base, column, and entablature together compose an *order* (see **Architecture** [Architectural terms]). Through the centuries, architects have used various kinds of columns. The ancient Egyptians favored heavy, massive columns. The Persian column was generally tall and slender.

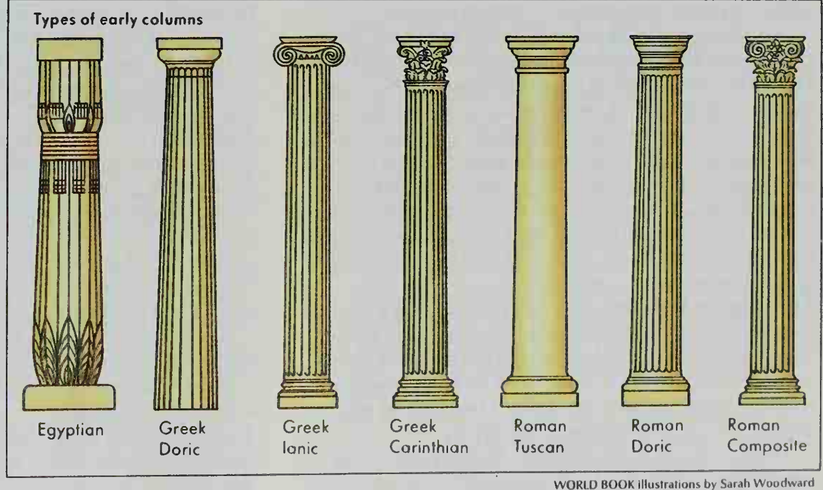
The Greek orders. The ancient Greeks refined the column to a high degree. They developed three basic classical orders—Doric, Ionic, and Corinthian. The shaft diameter of each type of column decreases gradually as the shaft rises, and each type has a subtle outward curve called *entasis*.

The Doric column is the oldest and simplest of the three types. It developed primarily on Greece's mainland and in its western colonies. The Doric style has no base. Usually, the shaft tapers upward to a height of 5 to 7 times its lower diameter. Along the shaft, 16 to 20 shallow vertical grooves called *flutes* meet in sharp ridges. One or several horizontal grooves, called *necking,* mark the meeting of the shaft and the capital. The capital has two parts of almost equal thickness. The upper, a flat square block called the *abacus,* rests on a round pillow-like tablet called the *echinus*. A celebrated building using the Doric order is the Parthenon, on the Acropolis of Athens (see **Parthenon**).

The Ionic column is more slender and decorative than the Doric. It was invented by the Greeks of the Aegean Islands and Asia Minor. The Ionic shaft stands on a circular base, which sometimes includes a square block at the bottom called a *plinth*. Its height is usually 9 to 10 times its lower diameter. Ordinarily, 24 flutes, divided by narrow *fillets* (flat surfaces), run along the shaft. The capital consists of *volutes* (scrolls) that separate the echinus from the abacus. Ionic columns stand on the Erechtheum at Athens (see **Acropolis**).

The Corinthian column is the most ornamental of the Greek orders. A variation of the Ionic, it has a similar fluted shaft, but it has a more elaborate capital. The capital consists of a central core resembling an inverted bell. The core is surrounded by carvings of acanthus leaves





WORLD BOOK illustrations by Sarah Woodward

A column is a vertical support that consists of a shaft and a capital and often rests on a base. Columns created by the ancient Egyptians, Greeks, and Romans greatly influenced later architecture.


Detail of drawing (about 1836) by George Catlin; The Newberry Library, Chicago, Edward E. Ayer Collection

The Comanche Indians won fame as skilled horseback riders. This drawing shows Comanche practicing battle maneuvers.

arranged in rows. From these leaves, four volutes project to meet the corners of the abacus. The monument of Lysikrates at Athens has Corinthian columns.

The Roman orders. The ancient Romans based their column designs on those of the Greeks. They also created two new orders—the Tuscan and the Composite. The Roman Doric order resembles the Greek but adds a simple molded base. The Tuscan order is an elementary version of the Doric without flutes. The Romans adopted the Greek Ionic with little change, but they elaborated and enriched the Corinthian. The Composite order combines features of both the Ionic and the Corinthian.

The Romans also erected independent, isolated columns as memorials to famous people and events. Sculptors decorated many of these massive, towerlike columns with carved or molded horizontal or spiraling bands called *friezes* that portray events related to the memorial. An example is Trajan's Column in Rome.

Columns of later periods. During early Christian and medieval times, architects freely adapted the classical orders for use in basilicas and cloisters. The Cathedral of Notre Dame in Paris has a combination of classical and medieval styles. The Renaissance and Baroque periods revived the use of Roman-style columns, as in the colonnades of St. Peter's Square in Rome. In the 1800's and 1900's, all types of columns were used, particularly on public buildings. William J. Hennessey

See also pictures of columns in **Architecture; Pompeii; Rome; Washington, D.C.; World, History of the.**

Coma is a state of deep unconsciousness. The word comes from the Greek word *koma,* meaning *deep sleep.* People in comas ordinarily cannot be aroused by stimulants such as spirits of ammonia, light slapping, or a pinprick. Causes may include drug overdoses, seizures, head injuries, tumors, strokes, diabetes, and diseases of the liver or kidneys. Doctors treat coma according to its cause. For example, if it is caused by a drug, the doctor gives an antidote. James N. Davis

Comanche Indians, *kuh MAN chee,* were a southern Plains tribe that hunted buffalo from Nebraska to northern Mexico. They won fame as the most skilled Indian horseback riders of the Southwest. In battle, many Comanche eluded arrows and bullets by hanging against the side of—or even under—their horses.

The Comanche lived chiefly as hunters and followed wandering buffalo herds. They hunted on foot until the 1700's, when the Spaniards brought horses to the Great Plains. Then the Comanche became master riders. For many years, the Comanche fiercely defended their land from other tribes and white ranchers.

In 1867, the Comanche agreed to move to a reservation in what is now Oklahoma. By 1900, whites had settled on parts of the reservation. In the early 1900's, the United States government transferred to each Comanche ownership of 160 acres (65 hectares) of land. Many disliked farming and sold or leased their land to whites.

According to the 2000 U.S. census, there are about 10,000 Comanche. Most of the Comanche living in tribal communities are in or near Comanche County, Oklahoma. Many of them work as accountants, bookkeepers, farmers, nurses, ranchers, or teachers. The Comanche, Apache, and Kiowa Indian tribes jointly own about 4,500 acres (1,820 hectares) of land in and around Lawton, Oklahoma. The tribes have developed two industrial parks there. C. B. Clark

See also **Indian, American** (picture: A village scene); **Quanah.**

Comaneci, *KOH muh NEECH* or *KAW mah NEHCH,* **Nadia,** *NAH dee uh* (1961-), a Romanian gymnast, became the first gymnast to receive a perfect score of 10 in the Olympic Games. In the 1976 Olympic Games in Montreal, Canada, Comaneci earned scores of 10 seven times. She won gold medals in the uneven parallel bars, balance beam, and all-around competitions. In the 1980 Olympics in Moscow, Comaneci won gold medals in the balance beam and floor exercise events.

Comaneci was born on Nov. 12, 1961, in Gheorghe Gheorghiu-Dej (now Oneşti), Romania. She defected to the United States in 1989. Dave Nightingale

Combine is a farm machine that cuts and threshes grain or other crops in one operation. The word *combine* stands for *combined harvester-thresher.* Some are large, self-powered machines. Others are smaller models pulled by tractors. Large combines cut paths wider than 20 feet (6 meters). Small ones cut paths about 6 feet (1.8 meters) wide. Those with special attachments can collect and shell corn, soybeans, and other crops.

As a combine crosses a field, a *cutting bar* on the front cuts the stalks of grain. Paddles on a long, rotating reel press the stalks against the cutting bar. The cut stalks fall onto a platform, and a *feeder* carries them to a *threshing drum.* In the drum, a revolving cylinder beats most of the grain off the stalks, creating straw. The grain falls through a grate into a *grain pan.* The straw moves to *straw racks,* which tumble it to remove any remaining grain. The straw then drops from the combine.

The grain passes from the grain pan to a series of sieves, where a fan blows the husks away from the kernels. The kernels fall through the sieves and are carried to storage in a *grain tank.* Finally, an *unloading conveyor* empties the grain from the grain tank into trucks or wagons that transport the grain to storage bins.

One of the first successful combines was built in the 1830's by Hiram Moore and John Haskall, near Kalamazoo, Michigan. It was pulled by 20 horses. A wheel that rolled along the ground drove the cutting and threshing machinery. Later, steam engines and internal-combustion engines powered combines.

Most early combines were used west of the Rocky Mountains. Farmers elsewhere used reapers and threshing machines, which required more time and labor than did combines (see **Reaper; Threshing machine**). After World War I ended in 1918, new designs of combines, plus a labor shortage, caused more farmers to use combines. Since then, combines have replaced most reapers and threshing machines. Gerald E. Rehkugler

Combustion is a chemical reaction that gives off heat and light. In most cases, combustion involves the rapid combination of oxygen with a fuel to produce burning. The fuel may be a solid, liquid, or gas. Combustion occurs, for example, when oxygen in the air reacts with charcoal in a barbecue grill. When oxygen combines slowly with another substance, the reaction is usually called *oxidation.* The rusting of iron is an example of oxidation.

In most cases, combustion occurs between a gaseous fuel and the oxygen in the air. The fuel may begin as a solid or liquid, but it must be *vaporized* (changed to a gas, or vapor) before it can burn. Substances vaporize at their surface. The molecules on the surface are attracted to one another and the molecules underneath. Heat can energize surface molecules of liquids and some solids enough to overcome this attraction. These molecules then escape into the air. The process in which solids vaporize in this way is called *sublimation.* This process rarely occurs.

Most combustible solids turn into a vapor in a process called *pyrolysis* or *thermal degradation.* These solids consist of large molecules whose surface atoms are tightly *bonded* (joined) to the atoms underneath. Heat destroys bonds at or near the surface, thereby breaking up the molecules. Small molecules or molecular fragments that result can then escape from the surface, thus becoming vapors. In many cases, a solid material called *char* remains on the surface.

The lowest temperature at which a solid or liquid produces enough vapor for combustion is called its *ignition temperature.* The energy given off by burning fuel is called *heat of combustion.*

Sometimes, a substance suddenly ignites without having contact with a spark or flame. This is called *spontaneous combustion.* It occurs when chemical reactions within the substance produce heat that cannot escape. Spontaneous combustion may occur when piles of oily rags are left unattended. James G. Quintiere

See also **Fire; Oxidation; Oxygen; Sublimation.**

Comedy is a form of drama that deals with humorous or ridiculous aspects of human behavior. Most comedies have a playful mood and end happily.

In *comedies of character,* the humor comes from the major traits of the characters. *Comedies of ideas* deal primarily with social issues. *Situation comedies* rely on comic actions and events. Most *comedies of manners* are humorous treatments of the social codes of the upper classes. Most *romantic comedies* concern people who are in love. An exaggerated kind of comedy called *farce* is sometimes considered a separate type. But farce may be treated as a form of situation comedy.

The first important comic playwright was Aristophanes, who lived in Greece from about 445 to 385 B.C. Most of his comedies deal with public issues. The ancient Roman playwrights Plautus and Terence wrote situation comedies based on events from everyday life.

In the Middle Ages, farce was the major type of comedy. In the late 1500's and early 1600's in England, William Shakespeare wrote plays with almost every type of comedy, while Ben Jonson specialized in satiric comedies of character. In the mid-1600's, Molière became the most famous comic playwright in France, with plays similar to Jonson's. In the late 1600's, such English playwrights as William Wycherley and William Congreve raised the comedy of manners to a high level.

Many playwrights of the 1700's wrote sentimental comedies. These dramatists included Sir Richard Steele of England and Pierre Marivaux of France. Later in the 1700's, witty comedies were written by Oliver Goldsmith and Richard Brinsley Sheridan, both of England, and by Pierre de Beaumarchais of France.

In the early 1900's, the British dramatist George Bernard Shaw proved a master of the comedy of ideas, which discusses moral or philosophical issues without interrupting the humor. Noel Coward wrote comedies of manners about England's sophisticated society.

During the mid-1900's, the Irish-born playwright Samuel Beckett and Romanian-born Eugène Ionesco pioneered in the theater of the absurd, in which bizarre comic events mingled with serious action. The *dark comedies* of Harold Pinter in England and Edward Albee in the United States are an offshoot of this school. Since the late 1900's, a number of writers have specialized in situation comedies about everyday life. These writers included Alan Ayckbourn in England and Neil Simon in the United States. Gerald M. Berkowitz

See also **Drama; Humor; Burlesque.**

Comenius, *kuh MEE nee uhs,* **John Amos** (1592-1670), was a Czech educational reformer and religious leader. He described his ideal educational system in a book called *Didactica Magna (The Great Didactic),* which he finished about 1635. Comenius proposed that education be organized in graded stages, from easy to difficult. He also called for teachers to use kindness instead of harsh discipline and to teach certain classes in their students' native language rather than Latin.

Comenius, whose Czech name was Jan Amos Komenský, was born in Uhersky Brod, near Zlín, in what is now the Czech Republic. About 1616, he was ordained a pastor in a Protestant group called the Brethren, now the Moravian Church. Comenius became a bishop in 1648. Douglas Sloan

Comet, *KAHM iht,* is an icy body that normally travels around the sun in a long, oval orbit. A comet consists of a solid *nucleus* (center), a cloudy atmosphere called a *coma,* and one or two tails. The nucleus resembles a dirty snowball. It is made of ices of various kinds and of

rocky dust particles stuck in the ices. When the comet approaches the sun, some of the surface ices vaporize. The resulting gases and the particles stuck in the ices fly away from the sun, forming the coma and the tails.

Most comets have a nucleus that measures about 10 miles (16 kilometers) or less across. The comas of some comets reach diameters of nearly 1 million miles (1.6 million kilometers). Some tails extend to distances of 100 million miles (160 million kilometers).

Most comets can be seen only with a telescope. Some are visible to the unaided eye when they pass closest to the sun. We see comets because the dust in their comas and tails reflects sunlight. Also, their gases release energy absorbed from the sun, causing them to shine.

One of the most active comets seen in over 400 years was Comet Hale-Bopp. It came within 122 million miles (197 million kilometers) of Earth in March 1997 and was bright to the unaided eye because its unusually large nucleus gave off a great deal of dust and gas. The nucleus was about 18 to 25 miles (30 to 40 kilometers) across.

Composition. Scientists learned much about the composition of comets by studying Halley's Comet in 1986, when it crossed Earth's orbit. Five spacecraft flew past it and gathered information about its appearance and chemical composition. This comet has roughly equal amounts of ices and dust. About 80 percent of the ice is water ice. Frozen carbon monoxide makes up about 15 percent. Much of the rest is frozen carbon dioxide, methane, and ammonia. Scientists believe other comets are chemically similar to Halley's Comet.

In 2001, the United States space probe Deep Space 1 took detailed pictures of the nucleus of a comet called Borrelly. The photographs showed a rugged surface with deep cracks. The probe also detected evidence of water and carbon monoxide in the coma.

Orbits. Astronomers classify comets as *short-period comets* or *long-period comets,* depending on how long these bodies take to orbit the sun. Short-period comets take fewer than 200 years to orbit the sun; long-period comets, 200 years or longer.

Most known comets travel in elongated orbits about the sun. These orbits cross the almost circular orbits of the planets. As a result, comets sometimes run into planets and their satellites. In July 1994, for example, a comet named Shoemaker-Levy 9 collided with the planet Jupiter. Cometary collisions caused many of the craters on satellites of the outer planets, and on some of the inner planets and Earth's moon. Scientists believe short-period comets come from a band of comets called the *Kuiper belt.* This belt lies beyond the orbit of Pluto, usually the planet farthest from the sun. Long-period comets arrive from the *Oort cloud,* a collection of comets 1,000 times farther away than Pluto's orbit.

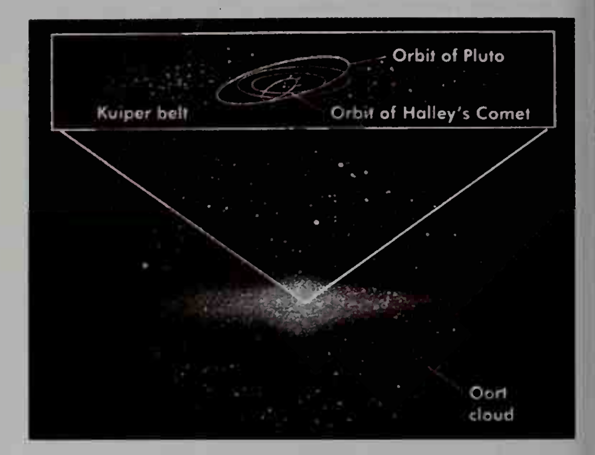
Direction of the tails. Dust particles released from the nucleus flow to a tail because sunlight pushes against them. At the same time, the *solar wind*—that is, rapidly moving electrically charged particles from the sun—interacts with the comet's gases. The interaction converts the gases to *ions* (electrically charged particles). The solar wind then pushes the ions back into an *ion tail* or *gas tail.* Because of these effects, comet tails always point away from the sun.

Origin and aging. Astronomers believe that comets formed when the planets did—about 4.6 billion years ago. The planets formed from a collection of gas, ice, rocks, and dust. Much of the ice and dust became parts of the giant outer planets—Jupiter, Saturn, Uranus, and



European Southern Observatory

Halley's Comet becomes visible to the unaided eye an average of every 77 years when it nears the sun.



Where comets come from

Comets that pass near the sun come from two groups of comets near the outer edge of the solar system, according to astronomers. The disk-shaped *Kuiper belt* contributes comets that orbit the sun in fewer than 200 years. The Kuiper belt lies beyond Pluto's orbit, which extends to about 4.6 billion miles (7.4 billion kilometers) from the sun. The *Oort cloud* provides comets that take longer to complete their orbits. The outer edge of the Oort cloud may be 1,000 times farther than the orbit of Pluto.

WORLD BOOK diagram by Terry Hadler, Bernard Thornton Artists

Famous comets

Name	First recorded sighting	Period of orbit (years)
Halley's Comet	About 240 B.C.	76
Comet Swift-Tuttle	69 B.C.	130
Comet Tempel-Tuttle	1366	33
Tycho Brahe's Comet	1577	unknown
Biela's Comet	1772	6.6
Encke's Comet	1786	3.3
Comet Flaugergues	1811	3,100
Great Comet	1843	513
Great September Comet	1882	759
Comet Ikeya-Seki	1965	880
Comet Bennett	1969	1,678
Comet Kohoutek	1973	unknown
Comet West	1975	558,300
Comet Shoemaker-Levy 9	1993	*
Comet Hale-Bopp	1995	2,380
Comet Hyakutake	1996	63,400

*Comet Shoemaker-Levy 9 was in a two-year orbit around Jupiter before it collided with that planet in July 1994.

Neptune. The comets remained as leftover bits of ice and dust. Comets lose ice and dust each time they return to the inner solar system. Eventually, some comets lose all their ice. They either break up into clouds of dust or turn into objects similar to asteroids. Some dust particles enter Earth's atmosphere. They glow as meteors, or shooting stars, due to friction with the atmosphere. Donald K. Yeomans

See also **Halley's Comet**; **Jupiter** (The impact of Comet Shoemaker-Levy 9); **Kuiper belt**; **Oort cloud**; **Space exploration** (Probes to comets).

Additional resources

Bonar, Samantha. *Comets.* Watts, 1998. Younger readers.

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Comics is an art form in which two or more cartoon pictures appear in a sequence. The pictures, known as *panels,* are usually combined with words. Most comics tell stories, though they have also been used for education, artistic expression, and other purposes.

Comics are popular reading material throughout the world, particularly in Europe and Japan. The popularity of characters from the comics has made them a useful tool in advertising. Many characters have appeared on radio and television and in motion pictures, as well as in books, plays, songs, and as toys. In the United States, the two most familiar forms of comics are the comic strip, first popularized in the late 1800's, and the comic book, which appeared in the early 1900's.

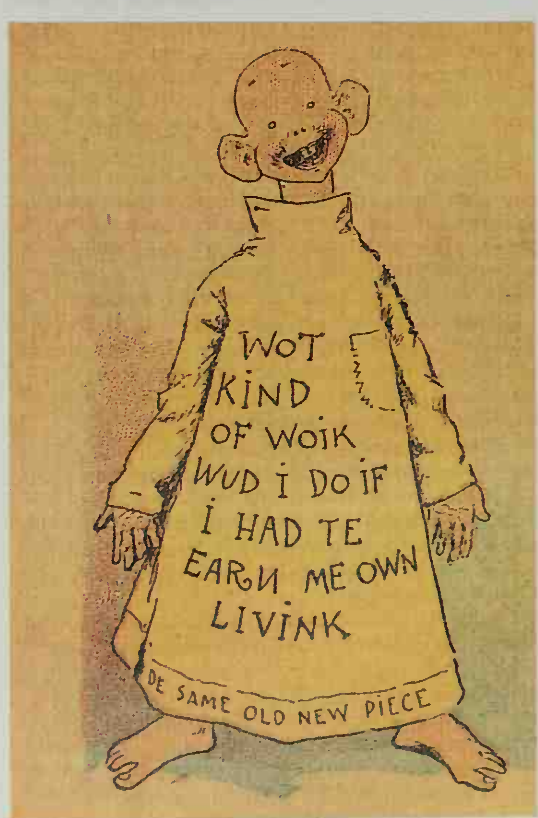
Comic strips appear regularly in newspapers and magazines. They feature a recurring set of characters in daily or weekly installments. Traditionally, a comic strip has three or four panels in weekday newspapers and as much as a half page in Sunday editions. Many comic strips are humorous. However, some feature serious adventure stories or real-life dramas. Other strips comment on social or political issues.

Most comic strips are drawn in a simplified style. But some adventure strips, such as Hal Foster's "Prince Valiant" and Milton Caniff's "Terry and the Pirates," have more realistically drawn characters and backgrounds.

The first widely popular American comic-strip character was the Yellow Kid. The strip was drawn by Richard F. Outcault for the *New York World* newspaper beginning in 1895 (see **Outcault, Richard Felton**). Comic strips boosted newspaper sales, and most papers quickly adopted the strips.

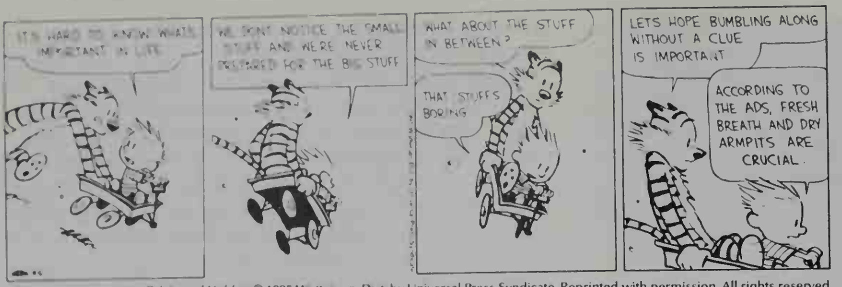
Many early comic-strip artists conducted bold experiments. For example, Winsor McCay drew the spectacular "Little Nemo in Slumberland." It portrayed the dreams of a boy named Nemo, who always awoke in the last panel. Other popular comic-strip characters of the early 1900's included Mutt and Jeff, Popeye, Krazy Kat, and Little Orphan Annie.

Superman was the first popular comics *superhero,* a character with extraordinary powers. He first appeared in a 1938 comic book, *above.*



Panel from the *New York Journal,* Nov. 22, 1896; San Francisco Academy of Comic Art

Outcault's "The Yellow Kid" was the first comic strip to gain widespread popularity. It featured the weekly adventures of a bald, grinning boy who always wore a yellow gown.



Calvin and Hobbes © 1995 Watterson. Dist. by Universal Press Syndicate. Reprinted with permission.

A comic strip is a sequence of cartoons, usually combined with words. Most tell stories. *Calvin and Hobbes* was a popular comic strip that told the humorous adventures of a mischievous boy named Calvin and his toy stuffed tiger, Hobbes.

Comic books are magazines that contain a single story or a collection of stories, often featuring a continuing set of characters. Today, many American comic books carry adventure stories that incorporate elements of fantasy and science fiction. Characters called *superheroes,* who possess extraordinary powers, are especially popular.

The first American comic books, such as *Famous Funnies* (first sold in 1934), collected popular newspaper strips. As demand for comic books increased, writers and artists created new material specifically for the new format. In 1938, Jerry Siegel and Joe Shuster introduced Superman, one of the most popular characters in the history of comic books. Superman inspired the creation of other heroes, notably Captain Marvel and Batman. Such artists as Will Eisner in "The Spirit" and Jack Cole in "Plastic Man" expanded the artistic possibilities of the comic-book format.

Artistic experimentation and adult themes flourished in the 1950's through the efforts of Harvey Kurtzman, artist and editor of *Mad.* The widespread publication of gruesome horror comics, however, drew much negative publicity. In response, several comic book publishers established a self-censorship program called the Comics Code Authority. It reviewed comic books before publication and removed material it judged offensive.

Superhero comics enjoyed renewed success in the 1960's. Artist Jack Kirby and writer Stan Lee created four superheroes called "the Fantastic Four" in 1961. The four were Mr. Fantastic, the Human Torch, the Thing, and the Invisible Girl. Kirby developed a dynamic style of composition and storytelling that influenced generations of superhero comics. Lee injected modern themes and down-to-earth problems into the lives of the heroes.

The "underground comics" of the late 1960's marked a radical departure in both style and content. Artists Robert Crumb and S. Clay Wilson used explicit sexuality and biting social satire. Their work was distributed outside of regular channels to bypass the regulations of the Comics Code Authority.

The new comics. The spirit of creative freedom and independence developed by the underground comics encouraged a revolution in the way comics are created and sold. Starting in the 1970's, many individuals and small companies began competing with the larger publishers. Independent or "alternative" artists experimented with new styles, more sophisticated formats, and stories suited to adults. For example, the *graphic novel* is a book-length comic book that tells a single complex story for adults. The most celebrated examples are *Maus: A Survivor's Tale* (1986) and *Maus II* (1991) by Art Spiegelman. They tell of the artist's relationship with his father and the experiences of his father and mother in the Holocaust.

Stores that specialized in comic books first appeared in the 1970's and 1980's. These stores account for the majority of the U.S. sales of comics. Scott McCloud

See **Cartoon** and its list of additional resources. See also **Capp, Al; Cartoon; Schulz, Charles Monroe.**

Comma. See **Punctuation** (The comma).

Commager, *KAHM uh juhr,* **Henry Steele** (1902-1998), an American educator and historian, won high praise for his books *The Growth of the American Republic* (with Samuel E. Morison, 1931) and *America: the Story of a Free People* (with Allan Nevins, 1942). Commager and Nevins also wrote *The Heritage of America* (1939). Commager edited *Documents of American History* (1934) and often wrote for periodicals on historical and public issues.

Commager was born on Oct. 25, 1902, in Pittsburgh, and earned a Ph.D. degree from the University of Chicago. He taught history at New York University, Columbia University, and Amherst College. He died on March 2, 1998. Gerald L. Gutek

Command. See **Air Force, United States** (Organization of the Air Force); **Army, United States** (Organization of the Army); **Navy, United States** (Organization of the Navy).

Commander in chief has supreme command of a nation's armed services. In the United States, the president is the commander in chief of the Army, Navy, and Air Force, and Marine Corps. The title of *commander in chief* may also be given to an officer commanding a theater of operations, a major naval fleet, a unified command of units from two or more of the military services, or a specified command assigned to a specific function. See also **President of the United States; Constitution of the United States** (Article II, Section 2). Allan R. Millett

Commander Islands, also called Komandorskiye Islands, are a Russian island group in the Bering Sea, east of the Kamchatka Peninsula. They cover about 715 square miles (1,852 square kilometers) and consist of Bering and Medny islands and two islets. The islands are mountainous and largely covered with tundra vegetation (see **Tundra**). The people fish and operate fox and seal fur farms. Craig ZumBrunnen

See also **Bering Sea.**

Commandments, Ten. See **Ten Commandments.**

Commando is a soldier who is trained to take part in specialized hit-and-run or raiding operations. United States soldiers who qualify for difficult training in commando operations can become members of the Army *Special Forces* or of Army *Ranger* units. There are similar units in the United States Air Force called *Spe-*

cial Operations units (formerly *Air Commandos*). In the U.S. Navy, such units are known as *SEAL* (for *se*a, *a*ir, and *l*and) teams.

The word *commando* was originally a Portuguese term. It was first used in South Africa during the 1830's to describe surprise attacks of the Dutch and Portuguese settlers against the African people. Prime Minister Winston Churchill suggested the name for the British *combined operations units* that used guerrilla warfare tactics during World War II (see **Guerrilla warfare**). Commando raids destroyed war plants and materials, rescued Allied agents, or tried out invasion tactics.

Famous commando operations during World War II included a raid on St.-Nazaire, France, in March 1942. Commandos destroyed the largest dock in western Europe. Canadian and British commandos staged the largest raid, on Dieppe, France, on Aug. 19, 1942. They fought for nine hours and suffered heavy losses. The U.S. Marine Corps employed commandos known as *Raiders* in the difficult Pacific campaign during World War II. United States Special Forces, Special Operations, and Ranger units, as well as SEAL teams, were used during the Vietnam War (1957-1975). In 1976, Israeli commandos in a daring raid freed 103 hostages held by terrorists in Uganda's Entebbe airport. John W. Gordon

See also **Army, United States** (Special units); **Rangers.**

Commedia dell' arte. See **Drama** (Italian Renaissance drama; picture).

Commerce. See **Business; Trade.**

Commerce, Chamber of. See **Chamber of Commerce; Chamber of Commerce of the United States.**

Commerce, Department of, is an executive department of the United States government that promotes the nation's economic development, international trade, and technological advancement. It also collects census data. The department helps the president form national economic policy and provides economic information and advice to other federal agencies and to businesses.

The secretary of commerce, a member of the president's Cabinet, heads the department. The president appoints the secretary with U.S. Senate approval.

Functions. The department provides a wide range of services. For example, the Census Bureau, a department agency, assembles data on such subjects as the nation's population, businesses, and international trade. The department's Bureau of Economic Analysis publishes statistics on the American economy.

To improve the economy, the department runs programs to create jobs and increase incomes in poorer areas of the country. It also helps minority group members establish new businesses and expand existing ones.

One of the department's most important responsibilities is promoting growth in trade with other countries. To encourage this growth, the department works to increase U.S. competitiveness in the world economy and to prevent unfair trade practices by other nations. The department also advises U.S. businesses that wish to export their goods or services.

To strengthen U.S. industries, the department encourages scientific and technological research and the adoption of new industrial technologies. It also develops measurement standards and techniques for industry and science and for government agencies. In addition, it issues patents and registers trademarks and promotes the development and widespread availability of advanced telecommunications technologies.



The seal of the Department of Commerce

To assist the nation's transportation industries, the department publishes special maps to aid in the navigation of airplanes and of ships at sea. It also measures the nation's land areas and coastlines and researches and manages U.S. ocean resources. The department's National Weather Service watches for hurricanes, tornadoes, and other dangerous weather conditions and provides weather forecasts.

History. Congress set up the Department of Commerce and Labor in 1903. The department handled matters concerning the censuses, corporations, fisheries, immigration, labor, navigation, measurement standards, and statistics. In 1913, Congress set up a separate Department of Labor and a new Department of Commerce.

Since 1913, many bureaus and agencies have been transferred to or from the Commerce Department. In

Secretaries of commerce

Name	Took office	Under President
George B. Cortelyou	1903	T. Roosevelt
Victor H. Metcalf	1904	T. Roosevelt
Oscar S. Straus	1906	T. Roosevelt
Charles Nagel	1909	Taft
William C. Redfield	1913	Wilson
Joshua W. Alexander	1919	Wilson
* Herbert C. Hoover	1921	Harding, Coolidge
William F. Whiting	1928	Coolidge
Robert P. Lamont	1929	Hoover
Roy D. Chapin	1932	Hoover
Daniel C. Roper	1933	F. D. Roosevelt
* Harry L. Hopkins	1938	F. D. Roosevelt
Jesse H. Jones	1940	F. D. Roosevelt
* Henry A. Wallace	1945	F. D. Roosevelt, Truman
* W. Averell Harriman	1946	Truman
Charles Sawyer	1948	Truman
Sinclair Weeks	1953	Eisenhower
Lewis L. Strauss	1958	Eisenhower
Frederick H. Mueller	1959	Eisenhower
Luther H. Hodges	1961	Kennedy, L. B. Johnson
John T. Connor	1965	L. B. Johnson
Alexander B. Trowbridge	1967	L. B. Johnson
Cyrus R. Smith	1968	L. B. Johnson
Maurice H. Stans	1969	Nixon
Peter G. Peterson	1972	Nixon
Frederick B. Dent	1973	Nixon, Ford
Rogers C. B. Morton	1975	Ford
* Elliot L. Richardson	1976	Ford
* Juanita M. Kreps	1977	Carter
Philip M. Klutznick	1980	Carter
Malcolm Baldrige, Jr.	1981	Reagan
C. William Verity	1987	Reagan
Robert A. Mosbacher	1989	G. H. W. Bush
Barbara H. Franklin	1992	G. H. W. Bush
* Ronald H. Brown	1993	Clinton
Mickey Kantor	1996	Clinton
William M. Daley	1997	Clinton
* Norman Y. Mineta	2000	Clinton
Donald L. Evans	2001	G. W. Bush

*Has a separate biography in *World Book.*

1925, for example, Congress switched the Patent Office (now the Patent and Trademark Office) from the Department of the Interior to the Department of Commerce.

Critically reviewed by the Department of Commerce

Related articles in *World Book* include:

Census Bureau, United States
Flag (picture: Flags of the U.S. government)
Free trade zone
National Institute of Standards and Technology
National Oceanic and Atmospheric Administration
Weather Service, National

Commercial. See **Advertising** (Television; Radio; Creating advertisements).

Commercial art includes many types of art used for business purposes as well as illustration. It is often called *advertising art,* because much commercial art is used in the selling of products and services. Commercial art is different from *fine art,* such as painting and sculpture, because it must be reproduced by printing, by photographing, or by other methods.

Commercial artists work for advertising agencies, department stores, manufacturers, typographers, publishers, TV stations, and many other types of businesses. They create art for such things as advertisements, books, computer programs, filmstrips, logos, magazines, packages, and trademarks. The artwork in *World Book* is produced by commercial artists.

Commercial art studios range in size from only a few to more than 100 employees. More than half of all commercial artists work independently and are paid by assignment. They are called *free-lance artists.*

The early commercial artists were self-taught or had some training in fine art. These artists worked on design, drawing, lettering, and all steps in preparing a piece of artwork for reproduction.

During the middle and late 1900's, the field expanded and developed greatly. Today, many commercial artists specialize in such specific parts of commercial art as design, calligraphy, illustration, photography, and photo retouching. Specialists within these areas include fashion illustrators, product illustrators, book illustrators, technical illustrators, cartoonists, computer graphic artists, film animators, and photographers.

Some commercial artists become art directors. Art directors plan and direct the work of other artists. They work for such businesses as advertising agencies, design studios, graphics studios, and television stations. A majority of commercial artists specialize in one such field.

Commercial art is a relatively new profession. Few people were employed in the field before 1900, and educational training for a professional career in commercial art was not available until about 1930. Today, there are many commercial art schools that offer four-year training programs, and many colleges and universities offer degrees in commercial art. Charles P. Green

Related articles in *World Book* include:

Advertising
Animation
Cartoon
Design
Graphic arts
Photoengraving and photolithography
Photography
Poster
Printing

Commercial paper is a term used broadly to describe business documents that are either orders or promises to pay money. There are two main kinds of commercial paper, the *draft* and the *promissory note.* A draft is a written order to a business or individual to pay a specified amount of money to another business or individual. The most common type of draft is a check. A promissory note is a written promise to pay a specified sum of money to a certain person on a future date.

When financial experts speak of *commercial paper,* they use the term in a narrow sense to mean short-term promissory notes issued by corporations. Many corporations borrow money by selling such notes to investors. On the date specified on the note, the corporation pays the investor the full amount of the note, plus interest. The interest rate on most commercial paper is less than the interest on a bank loan. However, only large corporations with good credit ratings can issue commercial paper. Most commercial paper *matures* (becomes due) in less than six months.

Many people believe commercial paper is a good investment, particularly during periods of inflation. The short maturity period enables investors to redeem their money quickly and reinvest it at higher interest rates. However, such notes are *unsecured*—that is, they do not give the lender legal claim to any property if the loan is not repaid. William G. Dewald

See also **Check; Draft; Note.**

Commission, Military, is a written order and oath of service giving an officer rank in the armed services. In the United States, the president commissions officers with the approval of the Senate. An officer accepts the commission voluntarily, and it does not have to be renewed. A commission may be resigned if existing law permits. The president may remove an officer from the commissioned list for cause. A board of officers handles dismissals. The term *in commission,* when referring to a ship or an aircraft, means that the vessel or airplane is available for active service. See also **Canada, Armed Forces of.** Allan R. Millett

Committee of the whole is a committee composed of all the members present at a meeting of an organization. A group may form a committee of the whole when members wish to consider a matter informally together, instead of having a committee of a few members discuss the matter and report to the group. Legislative bodies and large organizations often form a committee of the whole.

The committee of the whole is a complicated, time-consuming device. The members of a group must first vote to *resolve* (change) themselves into such a committee. After the committee has been formed and has completed its discussion, the members must vote on the committee's proposal or report. They then vote to *rise from the committee,* or end the committee meeting, and report to the group. The chairman of the committee reads the report to the group. The group can then discuss and vote on the report.

Most organizations may consider a matter informally without forming a committee of the whole. This procedure is often a more practical means of dealing with group business. Ned A. Shearer

Committees of correspondence were organized by towns, counties, and colonies before and during the Revolutionary War in America (1775-1783). The first committee of correspondence was appointed by the town of Boston in 1772 at the suggestion of Samuel Adams. The

committee's purpose was to keep in touch with other Massachusetts towns in their struggle to uphold the rights of the colonists. The first colonial committee was appointed by Virginia in 1773. The committees played an important part in drawing the colonists together for their struggle with Britain. See also Committees of safety. Richard D. Brown

Committees of safety sprang up in the colonies to carry on necessary functions of government during the Revolutionary War in America. The committees provided the transitional government after colonial governors had been overthrown and before the colonies could set up their first state governments. In Connecticut and New Hampshire, the committees of safety continued their work even after the state governments had begun operating.

On July 18, 1775, the Second Continental Congress urged the colonies to set up committees of safety. The new committees took over much of the work of the earlier committees of correspondence, which had carried on vigorous programs of propaganda against the British since 1772. William Morgan Fowler, Jr.

See also Committees of correspondence.

Commodity Credit Corporation (CCC) is a corporation within the United States Department of Agriculture. The corporation works to stabilize and support farm income and prices. It also helps maintain balanced and adequate supplies of agricultural *commodities* (goods) and assists in the orderly distribution of commodities.

The corporation supports prices of agricultural commodities through loans, purchases, payments, and other activities. It sells agricultural commodities to other government agencies and to foreign governments, and it donates food to relief agencies. The corporation also helps develop new domestic and foreign markets as well as marketing facilities for agricultural commodities.

The Commodity Credit Corporation is managed by an eight-member board of directors appointed by the President. The secretary of agriculture serves as the board's director and chairperson. The corporation has no operating personnel. To carry out its programs, it uses mainly the facilities and personnel of the Agriculture Department's Farm Service Agency. The corporation's commodity office in Kansas City, Missouri, has specific responsibilities for the acquisition, handling, storage, and disposal of commodities. The Commodity Credit Corporation was created in 1933.

Critically reviewed by the Department of Agriculture

Commodity exchange is a centralized market for buyers and sellers of contracts related to a wide range of items. These items include agricultural goods, stocks, bonds, and foreign currencies. In the United States, the largest commodity exchanges include the Chicago Board of Trade, the Chicago Mercantile Exchange, the New York Mercantile Exchange, and the Board of Trade of the City of New York. A federal agency called the Commodity Futures Trading Commission regulates the exchanges.

Prices at a commodity exchange are set through a competitive auction process. By bringing together many buyers and sellers, the exchanges ensure that the auctions set fair prices. The prices are then sent around the world on electronic networks and later published in newspapers. Individuals can buy or sell contracts on a commodity exchange by placing orders with brokers. These brokers then relay the orders to *floor brokers,* who do the actual trading at the exchange.

Commodity exchanges handle three basic kinds of contracts: (1) cash market contracts, (2) forward and futures contracts, and (3) options contracts.

Cash market contracts. The first major U.S. commodity exchanges opened in the mid-1800's in such cities as Chicago and New York City. They handled the buying and selling of corn, wheat, and other farm *commodities* (goods). At first, these goods were traded on the exchanges only in *cash markets,* also called *spot markets.* In these markets, farmers and other traders made contracts for immediate delivery of, and payment for, a certain quantity of an agricultural product.

Relying only on cash market contracts became impractical, however, as trade grew and as many farmers attempted to deliver crops at the same time—soon after the fall harvest. At such times, the deliveries overwhelmed transportation and storage facilities, and prices of goods fell sharply due to the great supply. In the following spring, supplies could dwindle to inadequate levels, causing prices to soar.

Forward and futures contracts. To organize agricultural buying and selling more efficiently, traders began using *forward contracts.* A forward contract guarantees the price of merchandise to be delivered on a future date. For example, in September a farmer can sell, and a cereal company can buy, a forward contract that promises to exchange 5,000 bushels of wheat in Chicago in the following March for $4 per bushel. Forward contracts allow farmers to space their deliveries to the markets throughout the year without worrying about the price they will receive. Also, the cereal company knows exactly what it will pay for the wheat on the future date. Reducing risk by locking in a price for a future date is called *hedging.*

By the 1860's, forward trading had expanded so much that forward contracts for many commodities became standardized. The standardized agreements specified commonly used delivery dates and locations and typical quantities and qualities of goods. Today, these standardized contracts are known as *futures contracts.*

Both hedgers and *speculators* can buy and sell futures and other contracts on commodity exchanges. Speculators trade contracts in the hope of making a profit. For example, a speculator who buys a wheat futures contract for $4.00 per bushel and later sells it for $4.50 per bushel earns a profit of 50 cents per bushel. The participation of speculators in futures markets helps the markets work by raising the number of buyers and sellers.

Traders of futures contracts deposit money known as *margin* to back up their pledge to fulfill their obligations under a contract. Margin deposits guarantee the fulfillment of the contract, even if the contract's market value changes or if one of the parties is unable, or refuses, to complete the deal. Each commodity exchange has a clearinghouse that holds margin in the form of a *performance bond* in a separate account for each trader. In addition, the clearinghouse monitors each contract's market value, which can vary from day to day. As the value changes, the clearinghouse, in a daily process called *marking to market,* adds money to a trader's ac-

count or asks the trader to deposit more money. The additional money deposited by the trader is called *variation margin.* By marking to market, the exchange's clearinghouse guarantees that all contracts will be fulfilled.

Financial futures. In the 1970's and 1980's, the exchanges developed futures contracts for foreign currencies, stock indexes, and bonds. These kinds of futures contracts are called *financial futures.*

Traders can use currency futures to hedge risk associated with changes in currency prices. Currency values can change from day to day. These changes make future currency prices hard to predict and thus increase the risk for businesses in international trade. A typical currency futures contract allows a trader to lock in the price of buying, for example, British pounds with U.S. dollars at a later date.

Traders can use *stock index* futures to limit risk associated with changes in stock market prices. Stock indexes are statistics that measure the level of stock prices. The value of stock index futures varies in direct proportion to changes in these indexes.

Bond prices are determined largely by interest rates. Traders therefore use bond futures to help reduce risk associated with changes in interest rates.

Businesses all over the world try to reduce risk that is connected with changes in currency values, stock prices, and interest rates. Thus, the amount of trading in financial futures contracts has grown far beyond the level of traditional agricultural contract trading. The exchanges have also introduced futures contracts for petroleum, gold, and other key commodities whose prices can be hard to predict.

Options contracts. The exchanges began organized trading in *options* in the 1970's. In 1973, the Chicago Board Options Exchange opened as a market for trading *call options* on major stocks. Buyers of these options acquire the right, but not the obligation, to buy a fixed number of shares of stock at a certain price at any time over a fixed period. For example, in August, an investor could buy a call option that expires in December and allows the purchase of 100 shares of a company's stock at $75 per share. If the price of the stock rises above $75 during the period, the call option becomes valuable. Its owner may then choose to exercise the option, forcing the option's seller to complete the deal. If the price remains below $75 throughout the period, the option buyer will not exercise his or her right.

In 1977, traders began trading *put options.* Buyers of put options acquire the right to sell shares of stock at a certain price at any time over a fixed period. Soon, the commodity exchanges began offering options for foreign currencies, stock indexes, bonds, and farm goods.

Like futures contracts, options contracts provide a way to minimize losses due to price changes. Assume, for example, that an investor owns bonds and plans to sell them in six months. By buying a put option, the investor guarantees a minimum selling price. The investor also leaves open the possibility that if the bonds' price rises, he or she can ignore the put option and sell the bonds at a higher price. Don Fehrs

Common carrier is a person or company that transports passengers and goods by water, land, or air for a fee. Common carriers include truck lines, express companies, bus lines, street railways, railroads, steamboat companies, air transport, and pipelines. Telephone and telegraph companies are also considered to be common carriers, though they do not transport goods. Stores that provide a delivery service solely for customers are not common carriers.

A common carrier has two legal obligations. First, it must serve anyone who can pay. Second, the common carrier is liable for loss or injury to goods or passengers carried. In the United States, the federal government regulates trade between states. States control common carrier operations within their borders.

It is generally stated that common carriers are responsible for any loss or accident except those due to an "act of God or of the public enemy." In this sense, an "act of God" means any unavoidable accident that occurs through no fault of a human being. A train being struck by lightning is an example of an "act of God." The term *public enemy* includes any government that is at war with the government of the common carrier. Robbers, bandits, and rebels are not regarded as public enemies in this sense. John R. Lorenz

See also **Federal Communications Commission; Interstate Commerce Commission.**

Common Cause is a citizens' organization that works for political and social reform in the United States. The group calls for reform of congressional procedures. It backed the successful effort to give 18-year-olds the right to vote in national elections and helped bring about the 1974 law that provides for federal financing of presidential campaigns. The law also sets limits on private contributions to presidential and congressional candidates, as well as on spending by presidential candidates who accept federal funds. The organization supports legislation that would limit spending by congressional candidates and favors limiting the influence of political action committees (PAC's) and interest groups. Common Cause supports no political party.

The organization maintains that none of the major problems in the United States can be solved unless the government becomes more responsive to the needs and desires of the general public. Therefore, Common Cause works to make Congress more representative and more responsible, especially in the operation of its committee system.

Common Cause was founded in 1970 by John W. Gardner, who was secretary of health, education, and welfare from 1965 to 1968. The headquarters of Common Cause are located in Washington, D.C.

Murray Clark Havens

Common law is a body of rulings made by judges on the basis of community customs and previous court decisions. It forms an essential part of the legal system of many English-speaking countries, including the United States and Canada. Common law covers such matters as contracts, ownership of property, and the payment of claims for personal injury.

Early in England's history, judges decided cases according to the way they interpreted the beliefs and unwritten laws of the community. If another judge had ruled in an earlier, similar case, that judge's decision was often used as a *precedent* (guide). After many judges decided the same question in a similar way, the ruling became law.

Common law is often contrasted with *civil law,* a body

of rules passed by a legislature. Under civil law, a judge decides a case by following written rules, rather than previous court decisions. Common law also differs from *equity,* a set of standards developed to allow greater flexibility in court decisions. During the late Middle Ages, England created courts of equity to decide cases that courts of common law might treat too strictly. These courts decided cases by broad principles of justice and fairness, rather than by the rigid standards of common law. The monarch's chancellor presided over a court of equity called the *court of chancery.*

The legal system of the United States has developed from English common law and equity. Only one U.S. state, Louisiana, modeled its legal system on civil law. Louisiana used the civil law of France, called the *Code Napoléon.* During the late 1800's, many states combined their courts of common law and courts of equity. One group of judges administers the combined courts. In Canada, similarly, only the province of Quebec based its legal system on French law. David M. O'Brien

See also **Civil law; Equity; Law** (Common-law systems; The Middle Ages; Beginnings of U.S. law); **Lien.**

Common market is an economic union of nations. Members of a common market work to eliminate trade barriers among themselves and to follow a uniform trade policy with nonmember countries. The members also work to achieve free movement of workers and financial capital from one member nation to another.

Nations form common markets to stimulate industrial growth and efficiency, to increase employment, and to make more and cheaper goods and services available to consumers. The European Union is an example of a common market. For more information on how a common market operates, see **European Union.**

Some groups of countries have partially or completely removed trade barriers among themselves. However, they are not true common markets because each member maintains its own trade policies with nonmember countries, and workers and capital do not move freely among the members. These groups—or the agreements that have established them—include:

Association of Southeast Asian Nations (ASEAN). Founded: 1967. Members: Brunei, Cambodia, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, and Vietnam. See **Association of Southeast Asian Nations.**

Australia-New Zealand Closer Economic Relations Trade Agreement. Went into effect: 1983. Parties: Australia and New Zealand.

European Economic Area (EEA). Founded: 1994. Members: Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Liechtenstein, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, and the United Kingdom.

European Free Trade Association (EFTA). Founded: 1960. Members: Iceland, Liechtenstein, Norway, and Switzerland. See **European Free Trade Association.**

Mercosur. Founded: 1991. Full members: Argentina, Brazil, Paraguay, and Uruguay. Associate members: Bolivia and Chile. See **Mercosur.**

North American Free Trade Agreement (NAFTA). Went into effect: 1994. Parties: Canada, Mexico, and the United States. See **North American Free Trade Agreement.** Robert M. Stern

Commoner, Barry (1917-), is an American biologist and educator. Since the 1950's, he has warned of the dangerous effects of technology on the environment. He has expressed concern over the use of technology without concern for its effect on the balance of nature. He has commented on the use of chemical fertilizers, detergents, nuclear power, pesticides, and incinerators.

Commoner has worked to make biology a useful tool in the solution of various human problems. He has urged other scientists to make their special knowledge available to the public with that same goal.

Commoner was born in New York City and graduated from Columbia University in 1937. He received a Ph.D. from Harvard University in 1941. Commoner served on the faculty of Washington University in St. Louis, Missouri, from 1947 to 1981.

In 1980, Commoner was the presidential candidate of the Citizens' Party, a liberal political party that he helped found. He and his party called for public control of the energy industry, an end to nuclear power development, and a switch to solar energy. Commoner's books include *Science and Survival* (1966), *The Closing Circle* (1971), and *The Politics of Energy* (1979). He joined the faculty of Queens College of the City University of New York in 1981. Sheldon M. Novick

Commons, House of. See **House of Commons.**

Commonwealth is a term sometimes used for a state, a country, or a group of states and countries. Any group of nations may sign a treaty pledging political or economic support to one another and call themselves a commonwealth. The term originally meant a group of people banded together for the common good.

The United States may be called a commonwealth. Pennsylvania, Massachusetts, Virginia, and Kentucky call themselves commonwealths. Puerto Rico and the Northern Mariana Islands are other U.S. commonwealths. The Commonwealth of Nations includes Australia, Canada, and the United Kingdom. Anthony D'Amato

See also **Commonwealth of Nations; Commonwealth of Independent States.**

Commonwealth Games are an amateur sports competition for members of the Commonwealth of Nations. Like the Olympic Games, these games are held every four years in a different country. The athletes compete in such events as boxing, cycling, swimming and diving, track and field, weightlifting, and wrestling.

In 1891, Astley Cooper, an English sports fan, proposed a periodic "festival" to improve ties among the nations and colonies of the British Empire. The first British Empire Games took place in 1930 in Hamilton, Canada. The name of the competition was changed to Commonwealth Games in 1974. Dave Nightingale

Commonwealth of Independent States is a loose association of nations that were formerly republics of the Soviet Union. The members are Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, and Uzbekistan. The headquarters are in Minsk, Belarus.

The Soviet Union consisted of 15 republics. In 1990, several republics declared independence. In August 1991, the Soviet Union began to break apart after an attempted coup. All the other republics except Russia declared independence during the coup or soon after. Russia proclaimed itself the Soviet Union's successor.

On Dec. 8, 1991, Russia, Belarus, and Ukraine announced the formation of the Commonwealth of Independent States (C.I.S.) and declared that the Soviet Union had ceased to exist. Eleven republics formally constituted themselves as the C.I.S. on December 21. The Soviet Union was formally dissolved December 25. Georgia joined the C.I.S. in 1993. Former republics Estonia, Latvia, and Lithuania did not join.

The C.I.S. was created for several reasons. The economies of the former republics were closely linked, and most members wanted to keep some of those economic ties. Each member also wanted to guarantee its own territory and sovereignty. The members also sought to reassure the rest of the world that the nuclear weapons of the former Soviet Union were under reliable control (see **Arms control** [History of arms control]). Basically, the C.I.S. was intended to help the new countries continue to work together and thus make the breakup of the Soviet Union as peaceful as possible.

However, C.I.S. members disputed various matters. The C.I.S. originally aimed to have a single military for all its members but later abandoned that plan. Each member created its own armed forces. Russia and Ukraine disputed the ownership of the Black Sea fleet. They resolved the dispute in 1997. Many members rejected the idea of continuing to use the ruble—the former Soviet monetary unit—as their own official currency. Each C.I.S. country created its own currency.

Experts believe many of the commonwealth's problems result from a lack of clear purpose or structure. Russia, for example, seemed to see the C.I.S. as permanent. Other members expressed fears that Russia might dominate the C.I.S. and use it as a means to gain control over the former republics. Some members, such as Ukraine, viewed the C.I.S. as a temporary association to help the former republics become truly independent. The C.I.S. does not have a charter that sets forth its duties and powers. It also lacks a governing body to enforce decisions or settle conflicts. Nancy Lubin

Commonwealth of Nations is an association of independent countries and other political units that have lived under British law and government. It includes the United Kingdom, about 50 independent nations that were once British colonies, and about 25 other political units, such as territories and dependencies.

The United Kingdom is involved in some way in the government of most of the units in the Commonwealth. In the rest, Australia or New Zealand has some involvement in the government. For a list of Commonwealth members and their status, see the table with this article. Members cover about a fourth of the earth's land surface and have about a fourth of the world's population.

The Commonwealth countries have a tradition of mutual cooperation that stems from their common history. The Commonwealth heads of government assemble from time to time to exchange views on important international issues. At these meetings, the leaders seek to identify common goals in economic and foreign affairs. They work to coordinate their national policies to pursue these goals. But the nations are not required to obey conclusions reached at the conferences.

The Commonwealth of Nations conducts various programs through Commonwealth agencies. For example, several jointly financed programs provide economic aid and technical assistance to developing nations in the group. The Commonwealth also supports agencies that promote cooperation in such activities as broadcasting, cable and satellite communication, education, health care, and scientific research. The Commonwealth Secretariat leads and coordinates Commonwealth activities. The secretariat has its headquarters in London.

Independent members of the Commonwealth consist of former British colonial areas, dependencies, or dominions that have become self-governing but have retained their Commonwealth ties. Despite the Commonwealth's tradition of cooperation, each nation has its own foreign policy, which reflects its own interests.

All the independent members recognize the British monarch as head of the Commonwealth. But the monarch is mainly a symbol and has no real power. The United Kingdom and about 15 other Commonwealth nations are monarchies that regard the British ruler as head of state. A few others have their own monarchs. Over half the Commonwealth nations are republics.

Dependencies are Commonwealth areas that do not have complete self-government. They are administered by independent Commonwealth members. Most dependencies are developing toward self-government.

Most of the dependencies are areas that have been annexed to the British Crown. This means that persons living in them are British citizens. These dependencies were formerly called *colonies* or *crown colonies.* They are now referred to as the United Kingdom Overseas Territories. A governor or commissioner appointed by the British government is the highest official in each territory. This official holds all political power in some territories. In other territories, the official shares power with an elected assembly. Some overseas territories have become practically self-governing. Most of these areas are ruled as though they were parts of the United Kingdom.

The term *dependency* may also be used to refer to other kinds of political units. These units include *crown dependencies, joint administrations, self-governing areas,* and other territories.

Crown dependencies are self-governing territories annexed by the British Crown. They are not bound by acts of the British Parliament unless the crown dependencies are named.

Joint administrations are controlled by two nations that have interests there. Each of the nations is responsible for its own property and personnel in the area.

Self-governing areas control their own internal affairs. They have agreed to let a Commonwealth nation handle their defense and foreign relations. But these areas can declare full independence at any time.

Other territories are dependencies of Australia or New Zealand. Each territory has an administrator chosen by the government of Australia or New Zealand. In some territories, this official holds all political power. In other territories, the administrator shares power with an elected assembly. Some territories have become nearly self-governing. Australia and New Zealand control defense and foreign policy for their territories.

History. The Commonwealth of Nations began to take form in the early 1900's. At that time, representatives of certain British colonies met with British officials at Imperial Conferences. All the colonies had self-government in domestic affairs. But the United Kingdom

managed their foreign policy and defense.

During the 1910's and 1920's, the self-governing colonies moved toward independence in foreign affairs. Representatives at a 1926 Imperial Conference declared all participating countries to be completely self-governing nations. They described these nations as equal in rank, "united by a common allegiance to the Crown and freely associated as members of the British Commonwealth of Nations." The Statute of Westminster, a British law of 1931, legalized the 1926 declaration. The original members were Australia, the United Kingdom, Canada, Ireland, New Zealand, Newfoundland, and South Africa.

In 1932, the Commonwealth nations established a system of trade called *Commonwealth Preference*. Under this system, the United Kingdom imported goods from other Commonwealth countries without imposing the usual tariffs. Other Commonwealth nations negotiated favorable trade agreements with each other.

Between 1947 and 1980, about 40 more British colonies became independent nations. Nearly all joined the Commonwealth. During this time, Newfoundland became a province of Canada, and Ireland and South Africa gave up Commonwealth membership because of disagreements with other members. By the mid-1960's, nearly half the members were black African nations. South Africa rejoined the Commonwealth in 1994.

In 1977, the United Kingdom finished a plan to discontinue its special trade agreements with Commonwealth nations. It began this plan in 1973, when it joined the European Community (EC), an economic association of European nations. In 1993, the EC members formed the European Union (EU) to increase economic and political cooperation among themselves, and the EC was incorporated into the EU. Individual Commonwealth members participate in the European Union and its trade agreements. See **European Union**. Anthony Sutcliffe

Related articles. All of the countries and most of the other political units in the accompanying table have separate articles in ***World Book***. Other related articles include:

British America	Flag (pictures)
Colony	Governor general
Commonwealth Games	Territory

The Commonwealth of Nations

Independent members

Antigua and Barbuda	Kenya	Seychelles
Australia	Kiribati	Sierra Leone
Bahamas	Lesotho	Singapore
Bangladesh	Malawi	Solomon Islands
Barbados	Malaysia	South Africa
Belize	Maldives	Sri Lanka
Botswana	Malta	Swaziland
Brunei	Mauritius	Tanzania
Cameroon	Mozambique	Tonga
Canada	Namibia	Trinidad and Tobago
Cyprus	Nauru	Tuvalu
Dominica	New Zealand	Uganda
Fiji	Nigeria	United Kingdom (Britain)
Gambia	Pakistan*	Vanuatu
Ghana	Papua New Guinea	Zambia
Grenada	St. Kitts and Nevis	Zimbabwe†
Guyana	St. Lucia	
India	St. Vincent and the Grenadines	
Jamaica	Samoa	

Overseas territories of the United Kingdom

Anguilla	Gibraltar
Bermuda	Montserrat
British Antarctic Territory	Pitcairn Island Group
British Indian Ocean Territory	St. Helena
British Virgin Islands	South Georgia and the South Sandwich Islands
Cayman Islands	Turks and Caicos Islands
Falkland Islands	

Territories of Australia

Antarctica (Australian)	Coral Sea Islands
Ashmore and Cartier Islands	Heard and McDonald Islands
Christmas Island	Norfolk Island
Cocos (Keeling) Island	

Areas associated with New Zealand

Cook Island	Ross Dependency
Niue Island	Tokelau

*Following a military coup in October 1999, Pakistan was suspended from the councils of the Commonwealth.
†After holding elections in March 2002 that were marred by politically motivated violence, Zimbabwe was suspended from the councils of the Commonwealth.

Communal society, *KAHM yuh nuhl* or *kuh MYOO nuhl*, is a community formed by people who believe that they can make a better life together than any of them could make alone. Members of communal societies value *collective* (group) needs above personal needs. Most of these societies are based on a shared interest, such as religion or politics. For example, members of a religious group known as the *Hutterites* have established communal societies that follow the laws of the Bible (see **Hutterites**). Some communal societies, such as the *kibbutzim* in Israel, are cooperative farming settlements (see **Kibbutz**). A communal society created as an example of a better world is called a *utopia*.

Communal societies differ from traditional society mainly in the ways they favor collective needs. No one owns private land in most communal societies. Some communal societies also may forbid marriage or single-family households. In nearly all successful communal societies, members do all their work for the community and restrict contact with the rest of society.

In the 1800's, such European thinkers as the Comte de Saint-Simon, Robert Owen, Étienne Cabet, and Pierre Joseph Proudhon reacted against the uneven distribution of wealth in society. These people sought a cure for society's evils through a communal society that would allow some private ownership, but not inherited wealth. These ideals inspired such well-known United States communal societies as Oneida, New York, and New Harmony, Indiana (see **Oneida Community** and **New Harmony**). Communal societies also appeared in other nations, including the United Kingdom, France, and Japan.

A strong interest in communal living also developed in the United States in the 1960's and the 1970's. During this period, young people formed thousands of cooperative groups called *communes* in all parts of the country. Most of these communes had been disbanded by the early 1980's. Present-day communal societies include Twin Oaks, near Louisa, Virginia, and over 100 Hutterite Bruderhofs (colonies) in South Dakota, Montana, and the Prairie Provinces of Canada. Jennie Keith

See also **Amanites**; **Brook Farm**; **Shakers**.

Communicable disease. See Disease (Infectious diseases; table).



WORLD BOOK photo

Newspapers and magazines



© PhotoDisc. Inc.

Cellular telephone



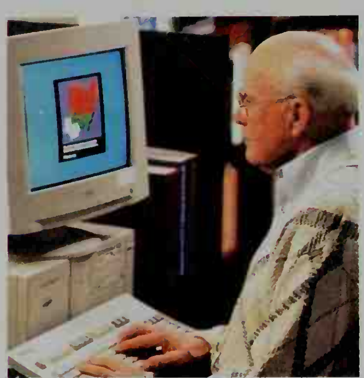
ChicagoLand Television News

Television news broadcast



WORLD BOOK photo

Letters



© John Henley, The Stock Market

The Internet



WORLD BOOK photo by Steven Spicer

Business meeting

The many kinds of communication enable people to share information and provide entertainment in a variety of ways. The pictures on this page show some examples of how people communicate with other individuals, with small groups, and with a large audience.

Communication

Communication is the sharing of information. People communicate both *interpersonally* (between individuals) and through communications systems that transmit messages between large numbers of people.

Individuals communicate using many different *modes*—that is, in many different ways. For example, they may communicate through gestures and facial expressions as well as by speaking and writing. Communications systems, also called *media,* range from long-used systems, such as books, to new systems, such as the Internet, a worldwide network of computers. Other major media include newspapers and magazines, sound recordings, film, telephone and telegraph networks, radio, and television. Together, the communications media form a vast industry of great social importance.

How people communicate

Interpersonal communication. No one knows how human communication began, but most scholars believe that communication through language began at least 150,000 years ago. The emergence of language was a decisive factor in the growing ability of early human beings to work together to make and use tools, shelters, and other products.

People communicate using not only language, but also other modes, such as gesture and body position, mathematics, and music. Modes of communication also include visual images, such as works of art. They vary in their use from culture to culture and from person to person. Individuals are often better at using one mode than another. Acts of communication often employ more than one mode.

Communication using language requires both a physical component—the central nervous system and muscle coordination—and cultural learning. Beginning early in life, human beings develop a basic understanding of several forms of communication. For example, babies about six months old begin to use hand gestures and distinct syllables simultaneously to express themselves. Face-to-face interaction with other people during the first three years of life is essential for a child to form the ability to communicate.

Communications systems are widely used in schools, businesses, government agencies, and households. Some communications systems, such as the tele-

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phone system, are networks through which users mainly exchange messages one-to-one. Others, such as magazines and radio or television broadcasting operations, transfer messages to many people at once. The Internet is an example of a *hybrid* system, capable of communicating both one-to-one and one-to-many.

Millions of people around the world work in the communications industry. Many kinds of workers are needed to make a communications system function. The television industry, for example, relies on writers, camera operators, technicians, and on-air talent. It also employs salespeople to sell advertising time, market researchers to study audience habits, and many other specialists.

Communications systems are organized differently in different countries. In the United States, electronic communications systems developed as private businesses whose main goal was to earn profits. In most other countries, they began as government services financed primarily through service revenues and taxes. Most telephone systems originally operated as parts of national postal services. In some countries, government subsidies helped support newspapers.

Economic forces shape and limit communications systems. For example, in many areas, television networks develop programs and services to help advertisers target desired audiences. Telecommunication systems are well developed in wealthy countries, but they have only begun to expand into developing regions.

The development of communications systems

Prehistoric times. After language developed, people exchanged news chiefly by word of mouth. Runners carried spoken messages over long distances. People also used drumbeats, fires, and smoke signals to communicate with others who understood the codes they used.

Early writing systems. Around 8000 B.C., people in southern Mesopotamia began using clay tokens that had different shapes and markings. They probably used these tokens originally for such functions as counting and record keeping. These crude numerical notations gradually combined with pictures. Sometime before 3000 B.C., this combination emerged as the writing system known as *cuneiform,* which used wedge-shaped characters. Many scholars believe cuneiform was the first writing system.

Other people probably invented their own writing systems independently, based on other principles and using other materials. For example, early systems of writing developed in Egypt, China, the Indus Valley (now part of India and Pakistan), and Central America.

Over time, early writing systems became increasingly *phonetic* —that is, they used symbols to represent individual speech sounds instead of objects. They also became increasingly *abstract*—that is, they used symbols that represented ideas rather than actual objects. Eventually, writing became so abstract that it became *alphabetic.* Alphabets made it possible to write down any word in the spoken language using comparatively few characters. Nonalphabet writing systems are still used in many parts of the world. In written Chinese, for example, each character stands for a word or part of a word.

During ancient times, the letter was the primary medium for long-distance communication. Couriers carried letters on foot, on horseback, or by ship. They mainly distributed government ordinances and edicts. Military leaders also used homing pigeons to carry messages.

About 500 B.C., the ancient Greeks developed a fast method of sending messages from city to city. The system used a series of brick walls. The walls were close enough together so that each could be seen from the one next to it. Indentations along the top of each wall represented the letters of the alphabet. To send a message, a person lit fires in the appropriate places on the wall. A watcher on the next wall saw the fires and relayed the message. This system of communication is called a *visual telegraph.*

The ancient Romans got news from a handwritten sheet called *Acta Diurna (Daily Events).* Government officials made a few copies each day and posted them in public. Often, slaves recopied these sheets and delivered the duplicates to readers throughout the Roman Empire. Using the empire's extensive network of roads, the messengers carried mail over land at a speed of up to 50 miles (80 kilometers) a day.

Throughout the ancient world, use of written communication remained severely restricted. Few people could read and write, and writing materials were costly. The chief writing surfaces were *papyrus,* made from a plant, and *parchment,* a kind of treated animal skin. Such materials required expensive, skilled preparation.

During the Middle Ages, which began about A.D. 400 and lasted about 1,000 years, news continued to spread mostly by word of mouth. Town criers walked the streets announcing births, deaths, and other events of interest. Entertainers, peddlers, wandering preachers, and others who traveled from place to place carried messages and news.

Christianity exerted a powerful influence on communications systems throughout the Middle Ages. Most books and other writings involved religious themes, and most scribes were monks. Scribes often toiled for months to finish a single volume, and so they produced few books. They decorated much of their work with pictures and designs in color or in gold or silver leaf. These illustrated books were luxury items, and they were written mainly in Latin—the language of the church and of scholars. Thus, they had limited distribution.

The rise of printing. Between the 1300's and the 1600's, several events increased the demand for written materials in Europe. One event was the growth of commercial merchant classes, who needed written materials for advertising and record keeping. Another was the Renaissance, a period of intellectual awakening that stimulated people's interest in books and other literature. Paper, which had appeared in Europe in the 900's, had become cheap and widely available. Hand copying could no longer satisfy the demand for written materials. In the 1400's, printing, which had long been known in East Asia, came to Europe.

The first European printers did not make books. Instead, they made playing cards, which were in great demand. An artist carved a raised image of a card on a block of wood. Then the printer inked the image and pressed a blank card against it. The picture was transferred to the card. Printers soon used this method, called *block printing,* to make books as well as cards. Printers in China, Japan, and Korea had practiced wood-

block printing of texts at least as early as the 700's, but it took a long time to carve the words into the blocks.

The invention of movable type made printing much faster. This printing system employed carved letters that could be used over and over again. After printing a page, a printer separated the pieces of type and rearranged them. A Chinese printer named Bi Sheng had invented movable type in the 1000's, but Europeans independently developed the technique much later.

Most historians consider Johannes Gutenberg, a German goldsmith, to be the inventor of movable type in Europe. In the mid-1400's, Gutenberg brought together several inventions to create a whole new system of printing. He made separate pieces of metal type, both capitals and small letters, for each letter of the alphabet. He lined up the pieces of type in a frame to form pages. Gutenberg inked the type using ink he had created from paint, dye, and other substances. Finally, he used a press similar to a wine press to put uniform pressure on the paper. His was the first printing press in Europe.

The effects of printing. Printing quickly became a vital new medium of communication and soon replaced hand copying. It spurred the production of Bibles and other religious texts in such commonly spoken languages as German, English, and French. As the number of literate people increased, common-language translations satisfied a growing demand for reading material.

Printing stimulated the rise of public opinion as a political and cultural force. Debates over church practices, economic issues, foreign policy, and social problems quickly erupted into print. Many of the materials printed during this period were single sheets called *broadsides* or pamphlets known as *chapbooks.* The new medium of print aided the Reformation, which began as an effort to reform the Catholic Church and ended with the establishment of Protestant churches.

By the 1600's, merchants, bankers, and commercial traders had become heavy users of print media. Printed newssheets called *corantos* appeared in the Netherlands, England, and other trading nations. The corantos reported mostly business news, such as which ships had landed and what goods they carried. The newssheets enabled merchants to learn of conditions affecting prices in distant markets. Corantos also printed advertising. They are considered the first true newspapers.

The 1700's. The Industrial Revolution, a period of rapid industrial expansion, began in the United Kingdom in the 1700's. The revolution spread throughout Europe and to North America by the early 1800's, bringing about dramatic changes in the lives and the work of the people. At the same time, a movement toward democratic government swept these regions. A continuing transformation of communications and shifts in the control of communications systems accompanied the economic and political changes. See **Industrial Revolution.**

The publication of books, magazines, and newspapers, as well as broadsides and chapbooks, made different kinds of information and entertainment available to

Highlights in the history of communication

About 20,000 B.C. — Prehistoric people used paintings and drawings to tell stories.

About 3500 B.C. — The Sumerians developed the first known system of writing.

About 1500 B.C. — The Semites invented the use of the alphabet for writing.

59 B.C. — The Romans began a handwritten newssheet that was a forerunner of today's newspapers.



WORLD BOOK illustration by Richard Hook

Smoke signals were one of the earliest forms of long-distance communication. Such signals could send only limited information—a warning, for example.



Deutsches Museum, Munich, Germany

Cuneiform writing consists of wedge-shaped characters stamped on clay. The clay cylinder above was inscribed during the 500's B.C. in Babylon.



Deutsches Museum, Munich, Germany

Wax tablets were once a common writing surface. The early Greeks wrote on such tablets with a pointed tool called a *stylus* and laced the tablets together.

more and more readers. By the end of the 1700's, European voyages of discovery and conquest had spread printing to many parts of the world.

Nearly from the beginning of the print era, monarchs in each European country granted a few leading printers a legal right, known as a *letters patent,* to publish and sell particular titles. This allowed kings and queens to censor what was published. During the 1700's, people challenged this system. In 1709, British Parliament passed the first national copyright law. Many other countries eventually adopted the British version of the modern copyright system or created their own. Copyright laws established clear legal rights to authors and publishers of books and other printed products. They also reduced rulers' influence over the print media. Literary property became increasingly valuable. Publishing surged during the late 1700's. But rulers continued to levy taxes on paper, thus restricting both the availability of printed materials and freedom of expression.

During the 1700's, private operators ran local letter delivery services in some European cities. But royal monopolies operating under exclusive charters granted by the king or queen ran the great postal systems that spanned long distances across kingdoms.

In the late 1700's, the French engineer Claude Chappe developed a visual telegraph similar to that of the ancient Greeks. It consisted of a series of towers between Paris and other European cities. An operator in each tower moved a crossbar and two large, jointed arms on the roof to spell out messages. An observer on the next tower read the messages and passed them on.

The 1800's brought a significant improvement in printing technology. They also brought the development of photography and of high-speed communication in the form of the telegraph and telephone.

The increasing impact of printing. In 1811, the German printer Friedrich König became the first to use a steam engine to power a press. Although printers continued to set type by hand, they could now print materials hundreds of times faster, and so could produce large numbers of copies cheaply. In 1814, *The Times* of London became the first newspaper to use König's press. By the mid-1800's, wide access to printed materials had led to a rapid increase in literacy in industrialized countries. Literacy was slow to increase in the developing countries of Africa, Latin America, and Asia, which produced only a small fraction of the world's printed materials.

The invention of photography further aided communication. Many American, British, and French scientists contributed to the development of photography, and no one person can be called its inventor. In 1826, a French physicist named Joseph Nicéphore Niépce made the first permanent photograph. Niépce's technique, which he called *heliography,* involved exposing a metal plate to light for about eight hours. As a result, Niépce could photograph only motionless objects.

The French painter Louis J. M. Daguerre worked as Niépce's partner for several years. In the 1830's, Da-

Date	Event
By A.D. 1	The Chinese invented paper.
About 1045	Pi Sheng, a Chinese printer, invented movable type.
Mid-1400's	The German metalsmith Johannes Gutenberg reinvented movable type.
Mid-1500's	The English made the first pencils of *graphite,* the substance used today.
1600's	Printed newssheets called *corantos* appeared.



Detail of an Italian manuscript (about 1331) by Giovanni de' Nuxiglia; Bibliothèque Nationale, Paris (SCALA/EPA)

During the Middle Ages, artists copied books by hand, letter by letter. They covered their work with gold, silver, and colored decorations called *illumination.*



Bettmann Archive

Printing from movable type was invented in Asia during the 1000's and in Europe during the 1400's. A shop of the 1600's is shown above. At the left, typesetters assemble type to form pages. In the background, an assistant inks a page. At the right, a printer turns a huge screw on the printing press to push paper against the type.

guerre developed the *daguerreotype,* a type of photograph that took only a few minutes to expose. About the same time, the British inventor William Henry Fox Talbot devised a photographic method that used a paper negative. His invention, which he called a *talbotype* or *calotype,* was not widely used because it produced less clear pictures than a daguerreotype. But the idea of using a flexible negative became the key to modern photography. The glass or metal plates used in other methods had to be changed after each exposure. With Fox Talbot's method, film could be moved through the camera and used to take a series of pictures.

Improvements in postal delivery. During the 1800's, the amount of mail delivered increased dramatically. Greater handling efficiency lowered postage rates, and national post offices introduced new services. By the late 1800's, the national post office had become one of the biggest and most important departments of government in many countries. The General Postal Union (now the Universal Postal Union) was established in 1884 to promote the exchange of mail between countries.

The electric telegraph. High-speed communication began with the invention of the electric telegraph. Inventors in the United Kingdom, Denmark, Germany, and other countries built various telegraphs during the early 1800's. But all these devices lacked a stable source of electric power and were difficult to use.

During the 1830's, the American painter and scientist Samuel F. B. Morse began work on an electric telegraph. After years of experimenting, he and his partner, Alfred Vail, developed a simple telegraph that had a stable current produced by batteries. The device sent messages over a wire at the speed of electric current. It used a code of dots and dashes, which we now call Morse code. Morse patented his invention in 1840. Newspapers started to use his telegraph within a few years. News agencies, including Reuters in the United Kingdom and the Associated Press in the United States, began using telegraphy to centralize and speed up news distribution. The telegraph also enabled the early railroads to safely schedule trains, thus avoiding crashes.

The telegraph rapidly became the chief means of fast long-distance communication. By the 1860's, telegraph lines linked most major U.S. cities. The first successful transatlantic telegraph cable connected Valentia, Ireland, to Heart's Content, Newfoundland, Canada, in 1866.

People in the world's poorer regions had little access to the telegraph. Even in wealthy countries, telegraphy was a business service used mainly by banks, railroads, newspaper publishers, and merchants. High service rates barred more general use. In most countries, telegraph service became part of the national post office.

The telephone. Alexander Graham Bell, a Scottish-born teacher of the deaf, patented a kind of telephone in 1876. Telephone exchanges began to form in U.S. cities in 1878, and many of them used Bell's design. In 1879, the National Bell Telephone Company consolidated all the exchanges into a national telephone network. The

Late 1700's — The French engineer Claude Chappe developed a visual telegraph.

1811 — Friedrich König, a German printer, invented a steam-powered printing press.

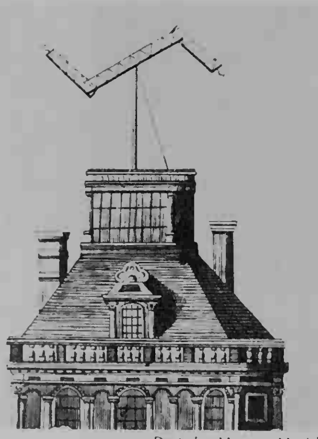
1826 — Joseph Nicéphore Niépce, a French physicist, made the first permanent photograph.

1830's — The French painter Louis J. M. Daguerre developed an improved photograph.



American Antiquarian Society, Worcester, Mass.

Postal service was established in many nations during the 1700's. This postrider carried mail between Boston and other cities in the American Colonies.



Deutsches Museum, Munich, Germany

The Chappe telegraph consisted of a series of towers. An operator in each tower moved a crossbar and two large, jointed arms to send coded messages.



Detail of *Intérieur d'un Cabinet de Curiosités;* Société Française de Photographie, Paris

A daguerreotype was an early type of photograph printed on a metal plate. Louis J. M. Daguerre took this picture of a collection of rare objects in 1837.

The beginning of speedy communication

This table shows how new means of communication steadily shortened the time needed to send a message from New York City to San Francisco during the mid-1800's.

Year	Fastest means of communication	Time, New York City to San Francisco
1845	Clipper ship around Cape Horn	About 4 months
1858	Overland stagecoach	About 25 days
1860	Telegraph to St. Joseph, Missouri; pony express to Sacramento, California; steamer to San Francisco	About 10 days
1861	Transcontinental telegraph	A few seconds

company, which later became AT&T Corp., owned many key patents. As a result, it was able to maintain a near-monopoly of telephone service for many years. The company eventually operated a group of subsidiaries, known as the Bell System, that served about 80 percent of U.S. telephones. Telephone services quickly developed in the other industrialized countries. Until the mid-1900's, however, there were more telephones in the United States than in all other countries combined.

Other inventions of the late 1800's expanded the variety of communications systems. These inventions included the typewriter in 1867, the phonograph in 1877, and motion pictures in the 1890's. By 1900, an international recording industry had developed, and customers bought tens of millions of phonograph records each year. Silent films, based mainly in France, England, Italy, and the United States, had become hugely popular by 1900 as well. Hollywood, California, the center of U.S. moviemaking, began to dominate the global film industry by the 1920's.

The development of electronics. Near the end of the 1800's, inventors began using a branch of science and engineering called *electronics* to send communications signals through space instead of along wires. The development of electronics led to the invention of radio, television, and other media of modern communication.

Electronics developed from ideas and experiments of several scientists. In 1864, the British physicist James Clerk Maxwell theorized that electromagnetic waves travel through space at the speed of light. In 1887, the German physicist Heinrich Hertz proved the existence of these waves.

The invention of radio. In the early 1890's, Nikola Tesla, an American inventor from Austria-Hungary, established theories for wireless communication. By 1893, he had assembled all the components necessary for a radio. In 1895, the Italian inventor Guglielmo Marconi demonstrated his own device, which he called the *wireless telegraph.* Marconi's device was widely recognized as the first successful radio. But his patents were later invalidated in favor of Tesla's, which had been issued earlier.

Radio quickly gained an important role in military and commercial ocean navigation. Meanwhile, its technolo-

1840 — The American painter Samuel F. B. Morse patented his electric telegraph.

1864 — The British physicist James Clerk Maxwell reported his theory of electromagnetism, which led to radio.

1866 — The first successful transatlantic telegraph cable linked Europe and North America.

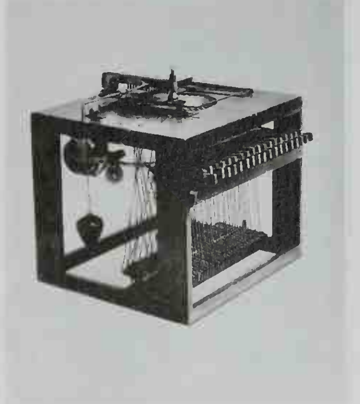
1868 — Three American inventors patented the first practical typewriter.

1876 — Alexander Graham Bell patented a type of telephone.



Bettmann Archive

Samuel F. B. Morse developed one of the first successful electric telegraphs. He also developed Morse code, a system of sending messages by dots and dashes.



Bettmann Archive

An early typewriter was patented in the 1860's by three American inventors—Carlos Glidden, Christopher Latham Sholes, and Samuel W. Soulé.



Bettmann Archive

Alexander Graham Bell designed one of the first successful telephones and demonstrated it at the 1876 Centennial Exposition in Philadelphia.

gy was improving. At first, wireless devices sent only Morse code signals. Then Reginald A. Fessenden, a Canadian-born physicist, attached a telephone mouthpiece to a wireless telegraph and became one of the first people to transmit speech by radio. On Christmas Eve in 1906, several radio operators picked up Fessenden's first broadcast. They were shocked to hear Christmas music and a Bible reading instead of a Morse code signal.

During the early 1900's, Lee De Forest of the United States and other electrical engineers developed various *vacuum tubes,* devices that could detect and amplify radio signals. Vacuum tubes played a vital role in the expanding long-distance telephone network. The devices also became a basic component in a new generation of radio broadcasting systems. Experimental radio stations, many connected with engineering schools or universities, appeared as early as 1908.

The development of the radio industry. In 1919, General Electric Company formed the Radio Corporation of America (now RCA Corporation). The new corporation acquired patents from all U.S. manufacturers of radio equipment. This gave the United States every advantage in developing the world's dominant radio communications system.

New radio stations quickly began operating throughout the United States. Two of the earliest commercial stations were KDKA in Pittsburgh and WWJ in Detroit. Both began regular broadcasts in 1920. In 1922, station WEAF in New York City accepted a fee to allow a company selling apartments to advertise on the air. This advertisement was the first radio commercial. Until that time, profits from the sale of radio sets paid for programs. The United States soon developed a system of commercial radio in which most programs are paid for by advertisers. In turn, sponsors profoundly influenced

Famous first words

"What hath God wrought!" Samuel F. B. Morse sent this message from Washington, D.C., to Baltimore over the world's first commercially practical telegraph line on May 24, 1844.
"Glory to God in the highest, on earth peace, good will toward men." This message of Aug. 16, 1858, was the first official communication sent over a transatlantic cable.
"Mr. Watson, come here. I want you!" Alexander Graham Bell spoke these words, the first communication by telephone, on March 10, 1876. Bell had accidentally spilled a jar of acid and was calling for his assistant, Thomas A. Watson.
"Mary had a little lamb." Thomas A. Edison recited this verse, the first phonograph recording, in 1877.
"S." Guglielmo Marconi received this signal, the first transatlantic wireless message, on Dec. 12, 1901.
"Wait a minute, wait a minute. You ain't heard nothin' yet." Al Jolson spoke these words in the first partly talking motion picture, *The Jazz Singer* (1927).
"That's one small step for a man, one giant leap for mankind." United States astronaut Neil Armstrong spoke these words on July 20, 1969, as he became the first person to set foot on the moon.

1877 — Thomas A. Edison developed the first practical phonograph.

1880's — The German physicist Heinrich Hertz discovered electromagnetic waves.

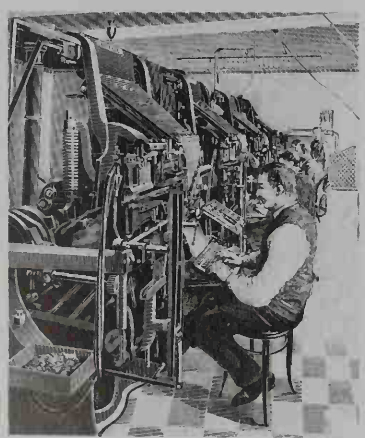
1884 — Ottmar Mergenthaler, a German-born mechanic, patented the Linotype machine.

1895 — The Italian inventor Guglielmo Marconi developed the *wireless telegraph* (radio).



Bettmann Archive

Thomas A. Edison's phonograph recorded sound on a cylinder covered with foil. This picture shows the inventor with an early version of his phonograph.



Historical Pictures Service

Linotype machines used a keyboard to set type mechanically. Their introduction sped the production of newspapers and other publications.



The Marconi Company

Guglielmo Marconi combined the ideas of several scientists to send signals through the air. His invention, the *wireless telegraph,* led to present-day radio.

the character of broadcast programs and target audiences. In most other countries, radio networks were government-funded, and advertising was significantly restricted.

The development of television. Television originated from the research and thinking of many people. Attempts to send pictures through space date back to the 1800's. Telecasting based on electronic scanning began in the United Kingdom, Germany, and several U.S. cities during the late 1930's. Electronic components developed during World War II (1939-1945), when parts for weapons and communications systems greatly contributed to the improvement of television technology.

The United States and other countries suspended television programming during the war, but broadcasting resumed just afterward. During the late 1940's, TV stations began operating all across the United States. Television broadcasters set up networks of several stations that shared some programming. Hollywood film studios supplemented their moviemaking profits by supplying the networks with an increasing share of TV programs. Cable television began about 1950 as a way to extend the reception of broadcast signals to rural communities. Videotape recorders that stored broadcast-quality pictures and sound on magnetic tape were first used by the television industry in the 1950's.

By the mid-1960's, more than 90 countries had television stations. U.S. film and television companies profited by selling programs to foreign broadcasters. They also worked to ensure that foreign television systems would accept commercial advertising. This effort succeeded in several countries, including Japan and the United Kingdom. The United States was becoming the center of an increasingly global commercial television industry. In the 1960's, communications satellites began to extend the overseas reach of the U.S. television industry. But commercial U.S. broadcasters bought few foreign TV programs to air in the United States. Many nations opposed such an imbalance in the industry, and they tried to impose limits on imports of American programs and on satellite services.

The digital age. During the late 1900's, computer technology advanced rapidly. As a result, the communications industry created and distributed more and more media content in *digital* (numeric) form.

In publishing. During the 1970's, newspapers and other print publications began to use computerized editing and typesetting systems. With these systems, writers and editors could type articles on computer keyboards and see the words displayed on a computer screen. The articles were stored in a computer as digital files that could then be used in many ways. For example, a device called a *photocomposition machine* could use a stored file to set an article in type on photographic film.

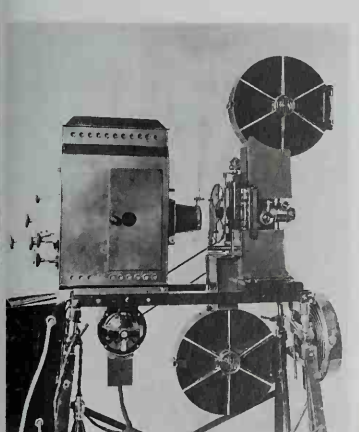
In the telephone industry, companies first used digital technology in the switches that set up and open circuits between callers. By the late 1970's, a branch of physics called *fiber optics* had made it possible for telephone

1906 — Reginald A. Fessenden, a Canadian-born physicist, transmitted voice by radio.

1907 — The American inventor Lee De Forest patented the *triode,* an improved vacuum tube.

1929 — Vladimir K. Zworykin, a Russian-born physicist, demonstrated the first all-electronic TV system.

1936 — The British Broadcasting Corporation made the world's first TV broadcasts.



Bettmann Archive

A motion-picture camera of about 1915 was used to film silent movies. Several inventors developed movie cameras in the late 1800's and early 1900's.



Bettmann Archive

Radio became a major source of family entertainment during the 1920's. This photograph shows a singer making a broadcast during the early days of radio.



British Broadcasting Corporation

One of the first TV broadcasts was a demonstration of self-defense techniques. It appeared in 1936 on the British Broadcasting Corporation (BBC).

companies to use light to send far more messages at one time than could be done with electric current or radio waves. In fiber-optic communication, a laser or light-emitting diode (LED) translates the electric signals of a telephone call or TV picture into light impulses. The light is aimed into one end of an *optical fiber,* a hair-thin strand of transparent glass or plastic. The light can travel great distances through the fiber without diminishing significantly in intensity. At the opposite end, a device reads the patterns of impulses and changes them into a duplicate of the original sounds and pictures.

In recording. Record companies introduced the compact disc (CD), a digital audio recording medium, in 1982. It quickly replaced the vinyl phonograph record and cut deeply into sales of audio cassette tapes. Digital video recording achieved its greatest success with a disk format called DVD, introduced in the late 1990's. Digital cameras also arrived in the late 1990's.

In television. Broadcast engineers invented digital television systems about 1990, and commercial digital broadcasts began in the late 1990's. Traditional over-the-air, cable, and satellite television services upgraded their systems to use the emerging digital technology.

The development of the Internet. By the 1980's, many businesses operated their own computer networks. These networks supported a host of functions, such as word processing, inventory control, research and development, and accounting. Many of these networks eventually joined the Internet, a worldwide computer network. The U.S. government had created it during the 1960's as a military network. The Internet grew to include tens of thousands of smaller networks and hundreds of millions of computers. *E-mail* (electronic mail) quickly emerged as the leading Internet service.

During the 1990's, a series of innovations transformed the Internet into a significant communications medium. In 1991, the World Wide Web came into being. The Web opened the Internet to a combination of media called *multimedia,* enabling it to display pictures, sound, and moving pictures as well as text. The development of a linking technique called *hypertext* enabled a user to jump between *Web pages,* screens of information available on the Web. Computer programs called *browsers* made it easier for people to use the Internet.

The Internet employs an efficient form of message distribution called *packet switching.* Individual messages are broken down into packets of data and sent out separately over the network. They are reassembled at their destination. For most messages, this process takes only a fraction of a second.

Growth and consolidation of the communications industry. During the late 1900's, many companies invested heavily in digital communications systems, leading to extraordinary growth in access to communications. Much of that growth occurred in developing countries, mainly in Asia and Latin America. But this expansion still did not bring electronic communication to all people. In fact, by 2000, at least a third of the world's

1947 — Physicists at Bell Telephone Laboratories invented the transistor.

Mid-1950's — Television networks began to record programs on videotape.

1960 — Xerox Corporation perfected *xerography,* a copying process.

1960 — *Echo 1* became the first satellite to receive radio signals from a ground station and reflect them back to earth.



Ampex Corporation

Tape recorders that recorded sounds on magnetic tape were developed in the 1930's. This 1948 recorder was the first one manufactured in the United States.



American Telephone & Telegraph Co.

Telstar I, a communications satellite launched in 1962, relayed telephone calls, TV shows, and other communications between the United States and Europe.



WORLD BOOK photo

Computers sped communication in the 1960's and 1970's by giving workers such as airline ticket agents access to large amounts of constantly changing data.

people had never used a telephone. People in some regions, such as sub-Saharan Africa, had little or no access to television broadcasts.

During the late 1900's and early 2000's, many previously independent newspaper groups, telephone companies, motion-picture studios, and television networks merged to form giant information and entertainment conglomerates. At the same time, several major communications companies began to expand their operations into other nations. The national broadcast systems of many countries began to accept commercial advertising for the first time. Corporate-owned broadcasting and telecommunications systems were established in most countries, often with foreign backers. As a result, noncommercial (also called *public service*) broadcast systems declined while commercial systems grew rapidly.

The study of communication

The two oldest areas of systematic investigation into human communication are *linguistics* (the scientific study of language) and nonverbal communication. Linguists began their studies during the late 1700's, when scholars first compared the world's languages and found similarities among them. The study of nonverbal communication dates from at least the 1800's, when teachers of acting and pantomime analyzed how facial and body movements convey emotion.

The modern study of nonverbal communication—sometimes called *body language*—includes both *kinesics (kih NEE sihks)* and *proxemics (prahk SEE mihks).* Kinesics is the study of the body and facial movements that accompany speech. The American anthropologist Ray L. Birdwhistell developed kinesics. Birdwhistell used slow-motion films of speakers to analyze their gestures and expressions. Another American anthropologist, Edward T. Hall, developed proxemics. Hall studied how people in different cultures use gestures, posture, speaking distance, and other nonverbal signs to communicate their feelings and social status. People would feel uncomfortable putting most such feelings into words. But proxemics enables people to send and receive messages without the use of words.

The study of communication emerged as a special field of research in the United States from the late 1930's through the 1950's. Scholars who made contributions to communication focused principally on critical issues associated with emerging new media systems.

The effects of media. The growth of film, radio, and television in the 1900's raised cultural questions. For example, some people became concerned about the impact of media violence on children and adolescents. First radio, then television, gained a prominent role in politics and elections. As a result, American social psychologists, especially Paul F. Lazarsfeld and Frank N. Stanton, began to study the effects of media on the public. Investigations by other U.S. researchers included those of the social psychologists Hadley Cantril, Carl I. Hovland, and Robert K. Merton. The research of these

1970 — Corning Glass Works produced the first optical fiber suitable for long-range communication.

1970's — Several manufacturers developed videocassette recorders.

Early 1980's — Several companies had begun to market cellular mobile telephones.

Late 1980's — Fax machines became widely popular in business.



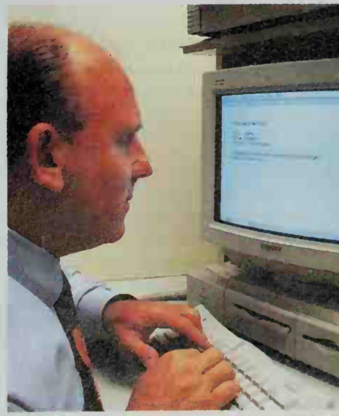
WORLD BOOK photo

Fiber-optic communication uses a laser to send signals through glass or plastic strands called *optical fibers.* Glass fibers are shown above.



David R. Frazier

Fax machines transmit and receive text and pictures over telephone lines. The woman in the picture above is sending a fax.



David R. Frazier

E-mail (electronic mail) enables users to send and receive messages on their personal computers. The man above is writing a message.

scholars inspired that of American social psychologist Bernard Berelson, sociologist Joseph T. Klapper, and educator Elihu Katz. Research on audience behavior and use of media by individuals continues today.

Communication and politics. Governments and other communicators have conducted extensive propaganda operations, mainly using newspapers, at least since World War I (1914-1918). During World War II, the warring nations added radio and other new media to their propaganda operations. Political scientists, most notably Harold D. Lasswell, began to study propaganda and its role in the formation of public opinion. Such study continued as the theory and practice of modern media propaganda carried over into the Cold War, a period of intense hostility between Communist and non-Communist nations following World War II.

Beginning in the late 1940's, researchers started to study the potential contributions of radio and television services to national economic development, especially for developing nations. The U.S. analysts Wilbur L. Schramm and Daniel Lerner studied how modern media could be used in such countries to spread information about farming and crops, medical care, and education.

Dallas W. Smythe of Canada, Herbert I. Schiller of the United States, and other scholars studied the *political economy* of communication. The political economy approach suggests that owners of communications systems can use them to exert control over cultural expression. Control of international communications systems can have an especially significant impact on social development throughout the world.

Communication and culture. During the late 1900's and early 2000's, the concept of culture became a focus of study in many academic disciplines, including that of communication. To social scientists, *culture* means a people's customary way of life, including arts, beliefs, customs, inventions, and technology. Cultural studies of communication began attracting interest in Europe in the 1960's and 1970's and soon gained supporters worldwide. Cultural critics Raymond Williams and Stuart Hall, and other scholars in the United Kingdom, developed this approach. Such study focuses on how the contemporary communications media shape people's understanding and action. Dan Schiller

Related articles in *World Book.* See the Communication section in the state, province, and country articles. See also:

Outline

I. How people communicate
- A. Interpersonal communication
- B. Communications systems

II. The development of communications systems

III. The study of communication
- A. The effects of media
- B. Communication and politics
- C. Communication and culture

Questions

When was movable type developed in Asia? When was it developed in Europe?
How are radio and TV broadcasting paid for in the United States?
What were *corantos?*
What are some of the different modes of communication developed during the 1900's?
How did World War II lead to an improvement of television technology?
How could radio and television aid developing countries economically?
What was the function of the earliest systems of writing?
What makes *packet switching* an efficient method of message distribution?
How did European rulers control the early print media?
What is the science of *proxemics?*

Additional resources

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Communications satellite is an artificial satellite that receives radio, television, and other signals in space and relays them back to earth. Because a satellite is high above the earth, it can direct radio waves to any place within a large region of the earth, even to a remote area. Without satellites, most radio transmissions could not reach far beyond the horizon. A satellite can send a message to many places at once. Satellites also offer instant service when new radio links are needed quickly. Many companies own satellites or pay a fee to use those owned by others.

Early communications satellites were built to carry long distance telephone calls. Satellites still perform this task, providing service in places where telephone cables are hard to install. They are also used to send telephone signals across oceans.

Communications satellites play a major role in modern television broadcasting. Satellites deliver programs to local cable television companies or directly to homes through direct broadcast satellite (DBS) systems. DBS subscribers use dish-shaped antennas to receive hundreds of television channels. Many stores and gas stations use communications satellites to approve credit card sales.

Types of satellites. There are two main types of communications satellites, based on their orbits: (1) *geostationary orbit satellites,* called GEOSAT's; and (2) *low earth orbit satellites,* called LEOSAT's. GEOSAT's circle the earth in *geostationary orbit,* an orbit that matches the rate of rotation of the earth. A station on earth is able to communicate with a satellite only while it is overhead. Because a GEOSAT stays over the same point, it remains within range of its station and does not need to be tracked.

A GEOSAT has a high-altitude orbit about 22,300 miles (35,900 kilometers) above the equator. From that altitude, it can communicate with about one-third of the earth at all times. A network of three or more GEOSAT's can transmit signals worldwide. Single satellites may serve one country or region.

A LEOSAT flies lower and faster than a GEOSAT. LEOSAT's may be only 200 to 500 miles (320 to 800 kilometers) above the ground and orbit the earth about every two or three hours. They must be tracked by stations on earth. Some LEOSAT's have *intermediate* or *medium orbits,* in which they travel slowly at high altitudes on one side of the earth and move quickly at low altitudes on the other. This type of orbit makes tracking easier because the satellite can be monitored longer during the high part of its orbit.

Globalstar

C-band receiver
Transmitting antenna array
Magnetic force sensor
Receiving antenna array
C-band transmitter
Earth sensor
Solar panels

A communications satellite for a mobile communication system receives and passes along telephone signals. The large antenna arrays handle communications to and from mobile telephones. The C-band receiver and transmitter exchange signals with earth-based facilities called *gateways* that link to other communication systems, such as ordinary and cellular telephone networks.



Globalstar

A satellite operations control center manages a network, also called a *constellation*, of communications satellites in low earth orbit. The control center oversees the launch and positioning of new satellites and plays an important role in tracking the satellites and controlling their orbits.

LEOSAT's can be smaller, cheaper, less powerful, and easier to launch than GEOSAT's because they are closer to the ground. Unlike a GEOSAT, however, a LEOSAT may be in tracking range for only a short time during an orbit. Once a tracking station loses contact, the transmission is interrupted. Some services, such as electronic mail, can operate with interruptions. Other services, such as TV and telephones, cannot. For a LEOSAT system to provide uninterrupted service, it must have numerous satellites, along with a way to hand off the signal from one satellite to the next.

Communications satellites fire small rockets occasionally to stay in the correct orbit. This process is called *station keeping*. With GEOSAT's, station keeping overcomes changes in earth's gravity and the effects of the sun and moon. LEOSAT's have such low orbits that the drag of the atmosphere slows them down, and station keeping restores their speed. A satellite's lifetime is limited by the amount of rocket fuel it can carry. Most satellites last 7 to 15 years.

How communications satellites work. Communications satellites carry many *transponders*. A transponder is an electronic device that receives signals, amplifies them, and retransmits them. Transponders are powered by solar cells and batteries. The incoming signals are called the *uplink*, and the outgoing signals are the *downlink*. These signals use different frequencies so they will not interfere with each other.

Antennas are the largest part of a satellite. Receiving antennas collect uplink signals for the transponders, and transmitting antennas send downlink signals back to earth. Most satellite antennas are dish-shaped.

The uplink and downlink signals may be in any of several *frequency bands*, ranges of radio frequencies set aside for a specific purpose. Frequency is measured in units called *megahertz* (millions of cycles per second), abbreviated *MHz*. Most LEOSAT's use the VHF *(very high frequency)* band, with frequencies from 30 to 300 MHz; the UHF *(ultrahigh frequency)* band, from 300 to 3,000 MHz; or a band called the *L-band*, with frequencies near 2,000 MHz. Most GEOSAT's use the *C-band*, with frequencies from 4,000 to 6,000 MHz, or the *K_u-band*, with frequencies from 12,000 to 14,000 MHz.

In general, GEOSAT's that share a frequency band must be kept about 2° apart in their orbit path around the equator to prevent signal interference. Thus, they are assigned to *slots*, orbital positions about 900 miles (1,450 kilometers) apart. There are only about 180 slots available per band. LEOSAT's face fewer restrictions in terms of orbital positioning.

The first communications satellites used *analog transmission*, a method of sending information through continuous changes in the frequency of radio waves. By the 1990's, *digital transmission* began replacing analog. Digital transmission sends information represented by a numeric code, usually a string of 1's and 0's, the same code used by computers. Digital transmission resists interference better than analog transmission and provides for clearer sound reception. The digital format also enables satellites to carry many more signals. A typical GEOSAT can carry up to 32 analog TV channels or several hundred digital channels.

History. Arthur C. Clarke, a British science-fiction writer, is credited with inventing communications satellites. In a 1945 article, he described a satellite in geostationary orbit that could serve as a relay station in the sky.

The first communications satellite was Score, a United States satellite launched on Dec. 18, 1958. Score broadcast a taped greeting from President Dwight D. Eisenhower. Echo 1, launched on Aug. 12, 1960, was the first satellite to relay voice messages from one location to another. It reflected radio signals back to earth. The American Telephone and Telegraph Company (now AT&T Corp.) launched Telstar 1, the first private satellite, on July 10, 1962. Score and Telstar were LEOSAT's. The first GEOSAT was Syncom 2, a communications satellite launched on July 26, 1963. The first commercial GEOSAT, Early Bird, also called Intelsat 1, was launched on April 6, 1965.

Nearly all of the commercial satellites launched after Early Bird were sent into geostationary orbit. However, in the 1990's, advances in computers, cellular telephones, and digital communications helped to revive commercial interest in LEOSAT systems.

Charles W. Bostian

See also **Communications Satellite Corporation; Intelsat, Ltd.; Satellite, Artificial.**

Communications Satellite Corporation (COMSAT), a private corporation, was a leading provider of communications satellite services in the United States and overseas during the late 1900's. COMSAT was the United States participant in INTELSAT, a global communications satellite system. Through INTELSAT, COMSAT enabled telephone messages, television signals, and other forms of communication to be sent between the United States and other countries. COMSAT also provided services to the shipping and offshore oil-drilling industries through INMARSAT, an international maritime satellite system.

In 1962, Congress authorized the establishment of COMSAT as a private corporation to administer satellite communications for the United States. In 2000, COMSAT Corporation merged with Lockheed Martin Global Telecommunications.

Communion, in Christian churches, is the *sacrament* (holy ceremony) of the Lord's Supper. The Gospels and I Corinthians report that at the Last Supper, Jesus told His disciples to eat, for this was His body, and to drink, for this was His blood. Most Protestants call the sacrament the *Lord's Supper.* Anglicans, Roman Catholics, and members of the Eastern Orthodox churches call the ceremony the *Eucharist* or *Holy Communion.* Some Protestant churches observe the ritual monthly or weekly. Others observe it four times a year. Roman Catholics must receive Communion during the Easter season, and often they receive weekly or daily Communion.

Some churches use individual wafers of unleavened bread and, especially among Protestant churches, individual glasses of wine. The modern liturgical movement has proposed celebrating the sacrament more frequently. It also proposes using a shared loaf of bread and a common cup of wine. Frank C. Senn

Related articles in *World Book* include:

Christianity (Beliefs)
Eastern Orthodox Churches (Services; Sacraments)
Mass
Protestantism (Belief in sacraments)
Roman Catholic Church (The Eucharist, or Mass)
Transubstantiation

Communism is a political and economic system that became one of the most powerful forces in the world. It shaped much of history from the early 1900's to the 1990's. Some people have considered Communism the greatest threat to world peace. Others have looked on it as the world's greatest hope.

The term *Communism* has several meanings. Communism can be a form of government, an economic system, a revolutionary movement, a way of life, or a goal or ideal. Communism is also a set of ideas about how and why history moves, and in what direction it is headed. These ideas were developed mainly by V. I. Lenin from the writings of Karl Marx. Lenin was a Russian revolutionary leader of the early 1900's, and Marx was a German social philosopher in the 1800's.

According to Communists, their long-range goal is a society that provides equality and economic security for all. Communists traditionally have called for government ownership rather than private ownership of land, factories, and other economic resources, called the *means of production.* They also have called for government planning of economic activity, and for strict rule by the Communist Party.

During the 1900's, millions of people lived under Communist rule. In 1917, Russia became the first state to be controlled by a Communist Party. Russia joined with three other territories in 1922 to form the Union of Soviet Socialist Republics (U.S.S.R.), or Soviet Union. By 1940, 12 more republics were added, and the Soviet Union had become one of the most powerful countries in the world.

After World War II (1939-1945), Soviet troops occupied most of Eastern Europe. The Soviet Union was thus able to help Communist governments take power in that region. In 1949, the Chinese Communist Party won a civil war for control of China.

The rapid spread of Communism after World War II brought about a struggle for international power and influence between Communist countries and non-Communist countries. This struggle was known as the Cold War. Most people believe that events in the late 1980's and early 1990's marked the end of the Cold War. These events included the collapse of several Communist governments in Eastern Europe in 1989 and the fall of Communism in the Soviet Union in 1991. By 1992, Communist parties remained in power in only a small number of countries, including China, Cuba, Laos, North Korea, and Vietnam.

The terms *Communism* and *socialism* are frequently confused. Communists usually refer to their beliefs and goals as "socialist." But socialists do not consider themselves Communists. Communists and socialists both seek public ownership or regulation of the principal means of production. But most socialists favor peaceful and legal methods to achieve their goals, while Communists have often used force without regard to law. Socialism may or may not be based on the teachings of Marx. Communism is based on the teachings of both Marx and Lenin.

Joan Barth Urban, the contributor of this article, is Professor of Politics at Catholic University of America and author of Moscow and the Italian Communist Party.

This article presents a broad survey of Communism in theory and as it was practiced in most Communist countries until about 1990. For a detailed description of life under Communism in China and the U.S.S.R., read the *World Book* articles on those countries. For a more complete understanding of how Communism compares with other political or economic systems, see **Capitalism** (How capitalism differs from central planning); **Economics** (Kinds of economies); **Government** (Who governs?); and **Socialism**.

Communism in theory

The Communism that developed in the 1900's was based on the theories of Marx as interpreted and modified by Lenin. These theories are often called *Marxism-Leninism.*

Early communism. The word *communism* comes from the Latin word *communis,* which means *common* or *belonging to all.* The idea of *communal* property dates at least from the time of the early Greeks. In the 300's B.C., the Greek philosopher Plato discussed communal ideas in his book *The Republic.* Plato proposed that a ruling class own everything in common, putting the welfare of the state above all personal desires. A number of early Christian groups had some form of community ownership of property.

Over the centuries, many philosophers and reformers supported such communist ideals as community ownership and equality of work and profit. Then, in the 1800's, Marx transformed Communism into a revolutionary movement.

The ideas of Marx. Marx's basic ideas were first expressed in the *Communist Manifesto* (1848), a pamphlet that he wrote with Friedrich Engels, a German economist. Marx believed the only way to ensure a happy, harmonious society was to put the workers in control. His ideas were partly a reaction against hardships suffered by workers in England, France, and Germany during the Industrial Revolution, a period of rapid industrial growth from the 1700's to the mid-1800's. Most factory workers and miners were poorly paid and worked long hours under unhealthful and even dangerous conditions.

Marx believed that the triumph of Communism was inevitable. He taught that history follows certain unchangeable laws as it advances from one stage to the next. Each stage is marked by struggles that lead to a higher stage of development. Communism, Marx declared, is the highest and final stage of development.

According to Marx, the key to understanding the stages of historical development is knowing the relationship between different classes of people in producing goods. He claimed that the owners of factories and other means of production—the *ruling class*—use their economic power to force their will on the people. Marx assumed that the ruling class would never willingly give up power, and so struggle and violence were inevitable. He saw such *class struggle* between the rulers and the ruled as the means by which history moves from one stage to the next.

Marx called for the abolition of *capitalism,* an economic system in which the chief means of production are privately owned. Under capitalism, Marx believed, a struggle takes place between the *bourgeoisie* (pronounced *BOOR zhwah ZEE*) and the *proletariat.* The bourgeoisie are the owners and managers of the means of production, and the proletariat are the workers. Marx argued that workers do not receive full value for their labor under capitalism, because the owners keep the profits. He believed that, under capitalism, wealth would become concentrated in the hands of a few people, and most people of the middle class would be forced to become workers. The workers' living standards would continually grow worse.

Finally, the workers would turn away from capitalism and their nation's political system. They would then revolt and seize control of industry and the government.

The workers would first establish a socialist state. Its government would be a *dictatorship of the proletariat,* a government controlled by workers, that would work to establish a classless Communist society. After classes had been eliminated, everyone would live in peace, prosperity, and freedom. There would be no more need for governments, police, or armies, and all these institutions would gradually disappear.

European reality in the early 1900's. By the early 1900's, capitalism was more successful in Europe's industrialized nations than Marx had predicted. Economic modernization was causing the middle classes to grow larger rather than smaller. The formation of labor unions, increased production of consumer goods, and the growth of democracy had led to a rise in living standards. Most Europeans felt an increasing sense of national pride, and few had turned away from their political systems.

During this period, many Marxists began to believe that social justice could be achieved within a democratic system. These moderates, called *democratic socialists,* thought such justice could be brought about by evolutionary rather than revolutionary means.

Lenin's contributions. Lenin believed that capitalism in Europe had escaped failure because of *imperialism*—a policy in which one country extends influence over other countries. Capitalists from European imperialist countries underpaid workers they hired in African and Asian colonies. This helped the capitalists produce goods cheaply, which in turn kept prices in Europe low. Low prices contributed to a high standard of living for Europeans, which helped prevent unrest in Europe. But the exploitation of workers in nonindustrial societies created the possibility of a Communist revolution there, which Marx had not foreseen.

Lenin agreed with Marx's idea that only revolutionary violence could bring about political change. But Lenin believed a highly centralized, tightly disciplined *vanguard* (leading group) of professional revolutionaries would lead the revolution. This vanguard would make up the Communist Party. Marx's idea of the dictatorship of the proletariat became, in Lenin's thinking, the dictatorship of the Communist Party, which claimed to represent the proletariat.

Communism in practice

In practice, Communism has varied from one Communist country to another. But until the late 1980's, certain basic features of Communism were shared by all Communist countries.

One of these features was *totalitarianism.* In totalitarian countries, the government controls almost all as-

pects of people's lives. Communist countries also were *party states.* In a party state, the ruling party dominates all government bodies. The countries had *centrally planned economies,* also called *command economies,* economies in which the state owned the means of production and the government planned most economic activity. Finally, Communist countries valued cooperation and *collective* (group) needs over personal freedom. In other words, they considered the well-being of the state and society to be more important than that of the individual.

The role of the Communist Party. The Communist Party performed four important roles in Communist systems. (1) It carefully selected party members. (2) It maintained total control over public policies. (3) It supervised every branch of government. (4) It carefully screened people for key jobs throughout society.

In Communist countries, the Communist Party functioned according to an idea introduced by Lenin called *democratic centralism.* According to this idea, all party members were required to support all decisions made by the party. Dissent from the *party line* (the party's policies) was called *factionalism* and could result in dismissal from the Communist Party.

Communist Party structure has varied from country to country. But Communist parties have shared certain basic characteristics.

The traditional Communist Party is structured like a pyramid. At the bottom of the pyramid are numerous local party organizations, formerly called *cells.* In the middle are various regional and district organizations. At the top is a party congress, made up of delegates from party organizations throughout the country.

Party congresses meet periodically, usually every three to five years. During meetings, each congress votes on issues facing the country and the party. It also elects the party's Central Committee, an administrative body.

Party congresses have more power in theory than in practice. They almost always vote according to the wishes of the most important Communist Party leaders. In addition, members of the Central Committee are already chosen before each congress, which merely approves those choices.

The most powerful decision-making bodies are the Central Committee, the Politburo, and the Secretariat. The Central Committee carries out the work of the party between congresses. It also approves the elections of members to two other administrative bodies, the Politburo and the Secretariat. The Politburo sets all important government policies. The Secretariat manages the daily work of the party. The head of the Secretariat, called the general secretary, is the most powerful person in the party and in the country.

The party state. Marx believed that in a Communist society, the powers of the state—and eventually the state itself—would gradually disappear. But no Communist country ever eliminated the state. Communists believed that a state dominated by the Communist Party was necessary to defend Communist countries against capitalist influence from other countries. Therefore, secret police as well as regular police forces and a strong military establishment would be needed until Communism had been attained worldwide.

In Communist states, all power rested with the Communist Party. The people who led the party also headed the government. The individuals who made up the government *bureaucracy* (the system of officials who carry out governmental functions) were all party members.

Communist governments established policies that they claimed were democratic, and thus representative of Marx's ideals. But these policies were actually undemocratic. For example, governments held local and national elections but limited the choice to only one candidate or to candidates of a single party. Legislatures that supposedly represented the people passed without question all laws proposed by Communist Party leaders. Constitutions that, in theory, protected people's rights were repeatedly violated by Communist leaders.

The centrally planned economy. Marx predicted that central planning of industrial and agricultural production would guarantee economic efficiency, job security, and income equality. Communist countries therefore *nationalized* (put under government control) factories and farms and established procedures for planning economic activity.

Communist planners made decisions that in non-Communist countries are made by individuals and corporations. Government planners determined what raw materials would be produced, when and where they would be produced, and what products they would be used to manufacture. The planners also decided to whom and at what prices the finished products would be sold. The planners had to ensure that resources and skilled labor were in the right place at the right time.

Communist economies experienced some success. Centralization enabled governments to focus their energies and rapidly industrialize their countries. It also helped the Soviet Union build up its military forces. Literacy and employment rates soared in Communist countries. In addition, Communist countries distributed income fairly equally. Therefore, the difference between the lowest and the highest wages was much smaller in Communist countries than in capitalist countries.

The centrally planned economy created serious problems, however, because it was inefficient. State-set prices did not reflect the actual cost of production, leading to waste of resources. The planned economy also failed to provide high-quality goods and services and could not respond quickly to changes in consumer demand. In many cases, consumer goods and housing were in short supply, and state-run farms did not produce adequate supplies of food. The shortages occurred partly because worker productivity and creativity lagged. Workers had little motivation to be productive because their wages remained about the same regardless of how much they produced.

In addition, the economy was not as fair as it may have appeared. Communist Party leaders and members of the bureaucracy enjoyed privileges denied to other citizens. These people and their families had special access to government cars, well-stocked grocery stores, comfortable housing, and better health care. As a result, they achieved a significantly higher standard of living than the average citizen, despite similarities in monetary income.

Restrictions on personal freedom. Communist leaders traditionally considered the needs of society

more important than individual rights and liberties. As a result, personal freedoms were severely restricted. The amount of police repression varied, however. For example, when Joseph Stalin was dictator of the Soviet Union from 1929 to 1953, millions of Soviet citizens were executed or sent to labor camps. The government also ordered people to spy on their neighbors and encouraged them to inform on their family members. Stalin adopted these measures to eliminate real and imagined opposition to his policies. Similar conditions existed in China under Mao Zedong, who ruled that country from 1949 to 1976.

After Stalin's death in 1953, most Communist governments shifted from open terror to more subtle forms of repression. For example, they threatened to fire people from their jobs or to deny them a new apartment if they opposed the government. Governments also used material rewards to encourage obedience from citizens. A similar transition occurred in China after the death of Mao.

In Communist countries, individuals generally were free to do and say what they wished among friends and family. But they were not allowed to publicly criticize Communist Party leaders or policies or to openly oppose the Communist system. Governments also did not permit people to establish organizations or publications that opposed Communism. In addition, writers who were critical of Communism were not allowed to publish their work. All these restrictions existed despite the fact that many Communist governments had constitutions claiming to guarantee the freedoms of speech, press, and assembly.

Communists in most countries discouraged religious worship because they considered religion a threat to Communism. Church members found it more difficult to advance in their jobs and were not allowed to join the Communist Party.

Communism in the Soviet Union

Before 1917. Marx had expected his theories to be tested in Germany, Great Britain, or some other highly industrialized country. But it was in relatively agricultural Russia that Communists first succeeded in setting up a Communist-controlled government.

During the late 1800's, Russia began to modernize. Although the country was still largely agricultural, its industry began to flourish. As industrialization increased, discontent grew among the rising middle class and workers in the cities. In addition, a series of bad harvests in the 1890's caused starvation among the peasants. During this period, revolutionary activity grew, and radical ideas—including Marxism—became popular.

In 1898, Marxists founded the Russian Social Democratic Labor Party. The party split into two groups in 1903. The Bolsheviks, led by Lenin, accepted his idea of a small Communist Party made up of professional revolutionaries. The Mensheviks wanted the party to have wider membership and to reach decisions through democratic methods.

In 1905, large numbers of Russians revolted against the czar and forced him to establish an elective assembly. During the next several years, the government enacted some reforms. But World War I (1914-1918) created more problems for Russia. The nation suffered heavy troop losses on the front and food shortages at home. In 1917, the people overthrew the czar. A democratic *provisional* (temporary) government was set up.

In autumn 1917, the Bolsheviks, led by Lenin, seized power and established a Communist government. When the Bolsheviks took over, they had fewer than 300,000 members in a country of more than 160 million people. The coup succeeded partly because the provisional government leaders did not want to withdraw from the war, and they could not carry out reforms while the war continued. The Bolsheviks also succeeded because of their effective organization and their appealing slogans, such as "Bread, Peace, Land."

Under Lenin. Lenin led Russia from 1917 until his death in 1924. For a short time, Lenin let the peasants keep farmland they had seized. He permitted workers to control the factories and to play important roles in local government. But the government soon tightened control and forced the peasants to give the government most of their products. The government also took over Russian industries and set up central management bureaus to run them. In addition, the state created a secret police force called the Cheka.

Soon after Lenin came to power, Russia made peace with Germany, but from 1918 to 1920 Russia was torn by civil war between Communists and non-Communists. The Communists defeated their rivals, who were divided and poorly organized. From the start, Lenin used force and terror against his political opponents. By 1921, conditions had become disastrous throughout the country. Peasant and sailor revolts broke out, and famine threatened. The world war, revolution, and civil war had brought Russia near economic collapse.

In 1921, realizing the need for a change in policy, Lenin introduced the New Economic Policy (NEP). The NEP called for Communists to cooperate with certain groups who were considered enemies of Communism. These included shopkeepers, peasants, engineers, scholars, and army officers. Russia's economy recovered steadily under the NEP. In 1922, the country became known as the Union of Soviet Socialist Republics (U.S.S.R.), or the Soviet Union.

By the time Lenin died in 1924, the Soviet Union had become a one-party state. All non-Communist political parties had been banned, and all public organizations—such as professional associations and labor unions—had become tools of the Communists. See **Lenin, V. I.**

Under Stalin. After Lenin died, leading Communists in the Soviet Union struggled for power. Through plotting and trickery, and by shifting alliances, Joseph Stalin gained complete control of the Communist Party and the Soviet government by 1929. Until his death in 1953, he ruled with an iron hand. The Soviet Union's economy and influence abroad grew rapidly—but at a great cost in human life and personal freedom at home.

Stalin established a centrally planned economy in the Soviet Union and, in 1928, began the *five-year plans.* These were comprehensive economic plans for the country. The first plan included a program that combined small peasant farms into *collective farms,* large farms owned and controlled by the government. In the early 1930's, Stalin ordered millions of peasants murdered or exiled when they resisted giving their land to collective farms.

Many other people opposed Stalin's policies during the 1930's. To crush this opposition, Stalin began a program of terror called the Great Purge. Communists suspected of opposing Stalin or his policies were executed or imprisoned. Stalin ordered many of his earlier Communist associates arrested or put to death. Numerous party officials were labeled "enemies of the people" and forced to confess imaginary crimes. The secret police assisted in the purges, in which army officers and citizens from all walks of life were imprisoned, sent to labor camps, or killed. The peak of mass terror came between 1935 and 1938.

During World War II, such political repression eased somewhat. The Soviet people rallied to defend their country from invading armies of the German dictator Adolf Hitler. But after the war ended, Stalin's secret police returned to using terror to maintain strict control over the people. See **Stalin, Joseph.**

Under Stalin's successors. Shortly after Stalin died in 1953, Nikita S. Khrushchev became head of the Soviet Communist Party. In 1958, Khrushchev also became the head of the Soviet government. He strongly criticized Stalin for his rule by terror. Khrushchev relaxed political control over writers, artists, and scholars. He also introduced reforms designed to improve the productivity and efficiency of the economy. But the reforms resulted in only slow gains.

In 1964, Communist Party officials forced Khrushchev to retire. Leonid I. Brezhnev replaced Khrushchev as head of the Communist Party. Brezhnev reestablished many of Stalin's rigid cultural and economic policies but did not return to rule by terror.

After Brezhnev's death in 1982, two other leaders briefly headed the government and the party. But no major changes were enacted until Mikhail S. Gorbachev became head of the country in 1985. Gorbachev's reform policies and the eventual collapse of Soviet Communism are discussed later in this article, in the section *The decline of Communism.*

The spread of Communism

The Comintern. The Bolsheviks thought the Russian Revolution of 1917 would spark revolution in other countries. But Lenin soon realized that worldwide revolutions would require careful direction and organization. In 1919, he established the *Comintern* (Communist International). The Comintern united all Marxist groups throughout the world who accepted Lenin's ideas on revolutionary violence and Communist Party organization.

The only Communist government established with the help of the Comintern was in Outer Mongolia (now called Mongolia) in the early 1920's. The Comintern succeeded there partly because Mongolians feared domination by the Chinese more than by the Soviets. Stalin had little faith in the Comintern, and he dissolved it in 1943.

World War II. The international instability that resulted from World War II provided opportunities for Communist gains in many countries. In 1939, the Soviet Union and Germany signed a *nonaggression pact,* an agreement in which they promised not to attack each other. A secret provision of the pact declared that certain areas in Europe would be divided between the two countries. In 1939 and 1940, the Soviet Union took over the Baltic countries of Latvia, Lithuania, and Estonia, and parts of Poland, Finland, and Romania. All of this territory became part of the Communist Soviet Union.

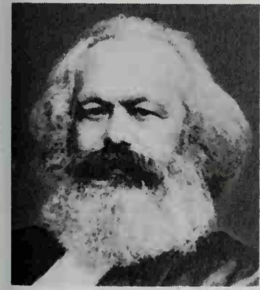
Toward the end of the war, the Soviet Union helped free many countries from German and Japanese control. The presence of Soviet troops enabled the U.S.S.R. to set up Communist-controlled governments in several of these countries, including Bulgaria, East Germany, Hungary, Poland, Romania, and North Korea. Winston Churchill, the former British prime minister, warned in 1946 that an "iron curtain" had descended across Europe, dividing eastern Europe from western Europe. Although supposedly independent, the Iron Curtain

1848 — Karl Marx and Friedrich Engels write the *Communist Manifesto.*

1917 — Bolsheviks (Communists) seize control of Russia; V. I. Lenin becomes dictator.

1922 — Soviet Union is established.

1929 — Joseph Stalin becomes dictator of Soviet Union.


Brown Bros.

Karl Marx, a German social philosopher, was the main founder of Communism.


Novosti

V. I. Lenin founded the Communist Party in Russia in 1917 and set up the world's first Communist Party dictatorship. Lenin ruled the country until his death in 1924.


AP Wide World

Joseph Stalin ruled the Soviet Union as a brutal dictator from 1929 until 1953.

countries were actually *Soviet satellites* (countries controlled by the Soviet Union). The satellites had to follow Soviet foreign policy and adopt Communist political and economic practices.

In some other countries, Communists who had led national resistance movements during World War II grew stronger. Local Communists took over the governments of Albania, Yugoslavia, and Vietnam near the end of the war with little or no help from the Soviets. A Soviet-supported Communist regime gained complete control in Czechoslovakia in 1948. Communists also became important political forces in France and Italy.

In China, the Communists and the ruling Nationalist Party both fought the Japanese, who had invaded the country during the 1930's. After World War II, a civil war broke out in China between the Communists and the Nationalists. The Communists, led by Mao Zedong, gradually gained control by winning widespread peasant support in the countryside. By 1949, they had taken over mainland China.

From the late 1940's to the 1960's, most other attempts by Communists to take power failed. For example, Communists in Greece, Malaya (now part of Malaysia), and the Philippines fought guerrilla wars but failed to gain power. Armed forces from Communist North Korea invaded non-Communist South Korea in 1950. The invasion resulted in a three-year war between the North Koreans backed by Communist countries and the South Koreans backed by non-Communist nations. Neither side won complete victory in the Korean War (1950-1953), and Korea remained divided between a Communist north and a non-Communist south.

The only major gain by Communists during this period occurred in Cuba. Fidel Castro became dictator of Cuba in 1959, and two years later, he declared his government to be Communist.

Expansion in Southeast Asia. In 1946, the Communist leader Ho Chi Minh led a nationalist uprising in the colony of French Indochina. By 1954, Indochina had been divided into Communist North Vietnam, non-Communist South Vietnam, and neutral Cambodia and Laos. Communists in Cambodia, Laos, and South Vietnam continued to fight the new non-Communist or neutral governments. North Vietnam sent troops and supplies to help the Communists, and China and the Soviet Union also sent equipment.

The struggle in South Vietnam developed into a major conflict, the Vietnam War (1957-1975). The United States sent troops to support South Vietnam. A cease-fire agreement ended U.S. participation in 1973, but the war continued until the Communists won full control of South Vietnam in 1975. In 1976, the Communists unified North and South Vietnam into the single nation of Vietnam. Communists also conquered Cambodia in 1975. In Laos, the government came under Communist control in 1975.

Communist influence in other areas. In Africa, a left wing military group controlled the government of Ethiopia from 1974 to 1991. The military government adopted socialist policies and developed close relations with the Soviet Union. In 1975, leftist guerrilla forces formed Marxist-Leninist governments in Angola and Mozambique. They controlled the governments of these countries until 1990. Other African nations had Marxist-Leninist governments for short periods in the 1970's and 1980's. In Central America, an alliance of Marxist-Leninist groups called the Sandinista National Liberation Front held power in Nicaragua from 1979 to 1990. In 1990, however, a candidate backed by 14 anti-Sandinista parties won Nicaragua's presidential election.

In southwestern Asia in 1978, a Marxist-Leninist party seized power in Afghanistan. However, many Afghans rebelled against the new government. In 1979, the Soviet Union sent troops into Afghanistan to prevent the overthrow of the government. The invasion resulted in a lengthy conflict between Soviet troops and Afghan rebels. The Soviet occupation of Afghanistan ended in 1989. The rebels overthrew the government in 1992.

- 1930's — Millions die in Stalin's Great Purge.
- 1940's — Soviet Union takes over Baltic countries. Communist governments established in Eastern Europe.
- Late 1940's — "Iron Curtain" separates Communist and Western nations; Cold War begins.
- 1949 — Chinese Communists, led by Mao Zedong, take over China.
- 1950 — North Korean Communists invade South Korea; Korean War begins.
- 1953 — Stalin dies.



Bettmann Archive

Soviet troops occupied many Eastern European countries in the mid-1940's. Their presence enabled the U.S.S.R. to set up Communist-controlled dictatorships in some of the countries.



Eastfoto

Chinese Communists, led by Mao Zedong, defeated China's Nationalist government in a war from 1946 to 1949. Mao is shown here on horseback, moving across central China in 1947.

The Cold War

Beginning after World War II, the United States and the Soviet Union competed with each other for international influence and allies in the Cold War. Both countries attempted to gain international power by influencing other governments in their favor, often with military or economic aid.

The Cold War was characterized by mutual distrust, suspicion, and misunderstandings between the two sides. These conditions led to occasional confrontations. For example, the two sides supplied military aid to opposing forces in the Korean War. Another confrontation came in 1962, when the United States learned that the Soviet Union had secretly installed missile stations in Cuba that could launch nuclear attacks on U.S. cities. After a week of extreme international tension, the Soviet Union agreed to United States demands that the missiles be removed. For more examples of Cold War events, see **Cold War**.

Alarmed by Communist expansion in Eastern Europe and in China, the United States and its allies began giving military and economic aid to non-Communist countries. They also pledged to help nations threatened by Communist take-overs. In 1949, Western nations formed the North Atlantic Treaty Organization (NATO). This alliance provided its members with mutual defense against a possible attack by the Soviet Union or any other aggressor. In 1955, the Soviet Union and its Eastern European allies signed the Warsaw Pact, a treaty to provide for their common defense. The signers claimed they drew up the pact in response to the creation of NATO. Each side invested in a massive arms race, a competition to acquire nuclear weapons and other arms.

In the 1950's, fear of Communism in the United States led to widespread accusations and investigations of suspected Communist activities. This pursuit of Communists came to be called *McCarthyism,* after Senator Joseph R. McCarthy, a Wisconsin Republican. McCarthy charged that many individuals were Communists or Communist sympathizers, usually with little evidence to support his charges. Nevertheless, many people lost their jobs or suffered lasting career damage as a result of such accusations. See McCarthyism.

The decline of Communism

By the late 1970's, Communism was in crisis in many parts of the world. The population of Communist China had almost doubled under Mao Zedong, and the Chinese government was barely able to provide adequate food for its people. Dissatisfaction with Communism in the Soviet-controlled countries of Eastern Europe was growing stronger.

The Soviet Union was confronted with serious economic problems, a dissatisfied middle class, and disappointment with the Communist political system among key members of the political elite. Hostility among the country's numerous ethnic groups had smoldered for years. Many non-Russians resented the power of ethnic Russians and began to demand more control over their own affairs. In addition, corruption was growing among members of the Communist Party bureaucracy. In Western Europe, Communist parties faced declining electoral support by the late 1970's.

By the late 1980's, most Communist countries had experienced long periods of little or no economic growth. Centralized planning proved to be inefficient, and it hindered the development of new technologies. As a result, most Communist countries could not compete economically with Japan and the industrial powers of the West.

The Soviet Union under Gorbachev. Mikhail S. Gorbachev became head of the Soviet Communist Party in March 1985. When he took power, the Soviet Union faced a declining economy burdened by heavy military expenses. These expenses included maintaining troops in Eastern Europe, supporting unpopular leftist regimes in developing countries, and competing in the arms

1950's — McCarthyism develops in the United States.
1961 — Fidel Castro declares Cuba to be Communist.
1975 — Communists win Vietnam War.
1985 — Mikhail Gorbachev becomes leader of Soviet Union.



UPI/Bettmann

Fidel Castro, *left,* declared Cuba to be Communist and began to receive Soviet support. Castro is shown above signing an agreement with Soviet leader Nikita Khrushchev.



AP/Wide World

Communist Viet Cong guerrillas from North Vietnam march in South Vietnam. In 1975, the Communist North defeated the non-Communist South in the Vietnam War.

race. In addition, Soviet technology lagged far behind that of the West, and aging industrial equipment contributed to economic inefficiency. Inefficiency, in turn, caused shortages of food and other consumer products for Soviet citizens.

Dissatisfaction with the Communist system attracted many people to the Western way of life. Gorbachev and members of the Communist Party elite observed the West while traveling there. Other people learned about non-Communist countries through foreign radio broadcasts, contemporary books and motion pictures, and professional journals. Citizens began to want the Soviet Union to become more like Western countries.

In response to the U.S.S.R.'s problems, Gorbachev began a program of reform. First, he introduced *perestroika,* or restructuring of the Soviet political and economic systems. Political reforms included the legalization of non-Communist parties and candidates and the creation of a functioning parliament. Economic reforms included lifting the ban on private businesses run by families and individuals, and modifications in the central planning system. To help win popular support for reform, Gorbachev increased freedom of expression in a policy called *glasnost* (openness).

Gorbachev also worked to improve Soviet relations with other countries. In 1987, he and U.S. President Ronald Reagan signed a treaty that called for the dismantling of all ground-launched Soviet and U.S. intermediate-range nuclear missiles. Relations with the United States also improved when the U.S.S.R. withdrew its troops from Afghanistan in 1989. Gorbachev's acceptance of the collapse of Communism in Eastern Europe further reduced tensions with the West.

Gorbachev was chosen for the new office of president of the U.S.S.R. in 1990. But his policies had begun to provoke the opposition of hard-line Communists in the party. His plans to give the 15 republics of the Soviet Union more control over their own affairs further angered the conservatives. In August 1991, leading hard-line Communist officials staged a coup against Gorbachev and removed him from power. However, the coup soon failed, and Gorbachev resumed his duties. Shortly after returning to power, Gorbachev resigned as the party's head but remained president of the national government. He also ordered the suspension of all Communist Party activities.

By late 1991, most of the republics that made up the Soviet Union had declared independence. In December, 11 republics joined to form a loose organization called the Commonwealth of Independent States. Gorbachev resigned as head of the Soviet government, and the Soviet Union formally ceased to exist.

1989 — Chinese citizens protest for greater democracy; military crushes the protests.

1989-1991 — Communist rule ends in most Eastern European countries and in the Soviet Union.

1991 — Soviet Union breaks up.



AP Wide World

Mikhail Gorbachev liberalized Soviet Communism as leader of the U.S.S.R.



East News from Sipa Press

A statue of Lenin is dismantled during Communism's collapse in Lithuania in 1991.

China after Mao. The Chinese economy was highly inefficient by the time Mao died in 1976. This was largely because of the failure of centralized planning, begun in the 1950's, including the establishment of huge collective farms. After Mao's death, a group of economic reformers led by Deng Xiaoping took control of the Chinese Communist Party. The new leadership allowed a return to private farming and the formation of small private businesses, such as tailor shops and restaurants. The government also reversed its policy of refusing foreign investment. It designated many coastal areas as *special economic zones* where foreign investors could produce consumer goods for export. These reforms resulted in substantial economic growth and in an improvement in living standards for many people.

The Deng regime maintained Communist Party control over the political system, however. In the late 1980's, many Chinese university students began demanding political reforms. In 1989, hundreds of thousands of students and workers demonstrated in Beijing's Tiananmen Square and in several other cities. They called for increased democracy and an end to corruption in government. However, the Chinese military crushed the demonstrations, and many protesters were killed. Shortly afterward, Communist Party and secret police controls were tightened.

In Eastern Europe, many people had always opposed Communism. Over the years, some Communists there also began to resist Soviet domination. In Hungary, some of these Communist reformers joined non-Communists in an uprising against Soviet control in 1956. Soviet armed forces invaded Hungary, put down the rebellion, and installed a new Communist regime. Soviet armed forces also crushed strikes and riots in East Germany in 1953.

The Communist government of Czechoslovakia, led by Alexander Dubček, adopted a reform program in 1968. The program included some genuine political competition, less centralized planning of the economy, and an end to censorship. Soviet leaders, fearful of losing control over Czechoslovakia, ordered troops into the country. Under pressure from the U.S.S.R., the Czechoslovak Communist Party replaced Dubček with a rigid pro-Soviet government in 1969.

In 1980, workers in several cities in Poland went on strike. The strikers called for higher wages, better working conditions, and political reforms. They also formed a free labor-union organization called Solidarity. In 1981, the Polish government, under pressure from the Soviet Union, imposed martial law and suspended Solidarity's activities. The Polish government officially outlawed the

free labor-union organization the following year.

In 1989, Communist parties began to lose control over the governments in four Eastern European countries that had been dominated by the Soviet Union since the late 1940's. These countries were Poland, Hungary, East Germany, and Czechoslovakia. The rapid liberalization of these countries occurred because the people realized that the Soviet Union, under Gorbachev, would not use armed forces to prevent it.

The Polish government ended its ban on Solidarity in 1989. That year, negotiations between Solidarity and the government led to partially free elections in which pro-Solidarity and other non-Communist candidates won control of the legislature. A coalition government was set up in the summer of 1989. It was the first Polish government since World War II not controlled by Communists.

Also in 1989, thousands of East Germans who had traveled to Hungary went to West Germany by crossing over a newly opened border between Hungary and Austria. Anti-Communist demonstrations soon followed in East Germany, and its hard-line Communist leadership resigned. In November, the country opened its long-closed borders with the West.

The disintegration of Communist authority in East Germany sparked anti-Communist demonstrations in Czechoslovakia. These demonstrations quickly brought about the downfall of the Communist government, and members of liberal opposition groups took power. In Romania, a bloody revolt led to the execution of Communist dictator Nicolae Ceauşescu. A group of former Communist Party members and officials called the National Salvation Front took control of the country. Communists who favored reforms also took power in Bulgaria.

In 1990, free multiparty elections were held in Czechoslovakia, Hungary, East Germany, Romania, and Bulgaria. Non-Communist parties came to power in Czechoslovakia, Hungary, and East Germany. The new East German government agreed to the unification of East and West Germany. Unification took place on Oct. 3, 1990. In Romania, the winning group was the National Salvation Front, which ran candidates as a political party.

In Bulgaria, the former Communist Party, which had renamed itself the Socialist Party, won the election. In 1991, the Communist Party won multiparty elections in Albania. But protests by Albanians led the Communists to form a coalition government with other parties. In early 1992, non-Communists took control of the governments in both Albania and Bulgaria.

Communism after the fall of the Soviet Union

By 1992, Communism was in retreat around the world as a system of government. It also was losing supporters in some non-Communist countries.

In Communist countries. By 1992, Communists held a monopoly on power in only a few countries, including China, Cuba, Laos, North Korea, and Vietnam. But the governments of China and Vietnam were introducing economic reforms.

In non-Communist countries. Hard-line Communist parties continued to exist in France, Greece, and Portugal, though they had relatively minor representation in legislative bodies. The once powerful Italian Communist Party split, and the larger of the two parties that resulted dropped its Marxist policies. The Communist Party of the United States may have had as many as 100,000 members in the 1930's. By the 1990's, only about 3,000 people belonged. In Eastern European countries and former Soviet republics, most Communist parties had reidentified themselves as socialist parties and abandoned Communist principles. Joan Barth Urban

Related articles in *World Book.* See Union of Soviet Socialist Republics and its list of *Related articles.* See also:

Biographies

Castro, Fidel
Ceauşescu, Nicolae
Deng Xiaoping
Engels, Friedrich
Guevara, Ché
Ho Chi Minh
Honecker, Erich
Hoxha, Enver
Hu Yaobang
Jaruzelski, Wojciech
Jiang Qing
Jiang Zemin
Kadar, Janos
Kim Il Sung
Li Peng
Lin Biao
Luxemburg, Rosa
Mao Zedong
Marx, Karl
Reed, John
Soong, Ching-ling
Tito, Josip B.
Zhao Ziyang
Zhou Enlai

Other related articles

Bolsheviks
Brainwashing
China
Cold War
Collective farm
Collectivism
Cuban missile crisis
Dictatorship
Economic determinism
Iron Curtain
Materialism
Mensheviks
Politburo
Propaganda (History)
Radio Free Europe/Radio Liberty
Russia
Smith Act
Socialism
Totalitarianism
Welfare state

Outline

I. Communism in theory
- A. Early communism
- B. The ideas of Marx
- C. European reality in the early 1900's
- D. Lenin's contributions

II. Communism in practice
- A. The role of the Communist Party
- B. Communist Party structure
- C. The party state
- D. The centrally planned economy
- E. Restrictions on personal freedom

III. Communism in the Soviet Union
- A. Before 1917
- B. Under Lenin
- C. Under Stalin
- D. Under Stalin's successors

IV. The spread of Communism
- A. The Comintern
- B. World War II
- C. Expansion in Southeast Asia
- D. Communist influence in other areas

V. The Cold War

VI. The decline of Communism
- A. The Soviet Union under Gorbachev
- B. China after Mao
- C. In Eastern Europe

VII. Communism after the fall of the Soviet Union
- A. In Communist countries
- B. In non-Communist countries

Questions

What did the word *communism* mean originally?
Who were the Bolsheviks? The Mensheviks?
What was McCarthyism? What led to it?
Who planned the Bolshevik Revolution of 1917?
What basic characteristics did Communist countries share until the 1980's?
Who wrote the *Communist Manifesto*?

How does socialism differ from Communism?
What problems faced the Soviet Union in the 1980's?
What was the Great Purge?
How did Lenin's ideas about Communism differ from Marx's thinking?

Additional resources

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Gwertzman, Bernard, and Kaufman, M. T., eds. *The Collapse of Communism.* Rev. ed. Times Bks., 1991.
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Communist Manifesto. See Communism (The ideas of Marx); Marx, Karl.

Communist Party. See Communism.

Community, in the social sciences, is a group of people who share similar beliefs and customs and who may live in the same area. The community ranks second only to the family among the oldest and most basic human institutions. Members of a community are linked by emotional bonds. They share a sense of belonging and feel an obligation toward other members of the group.

Since the earliest times, human beings have banded together in groups for companionship, help, and protection. The first communities consisted of small groups of people who inhabited a specific territory. Most of these communities were isolated and self-sufficient. Members of the community identified themselves strongly with the values and attitudes of the group. Membership in the community tended to be stable, and many people lived in the same group throughout their lifetime. Such traditional communities still exist in many rural areas.

The history of society includes a decline in the importance of the community. Large numbers of other institutions have taken over its functions. These institutions include schools, corporations, and regional and national governments. The community has not disappeared, however. Members of modern communities may not live in the same place. Instead, people from different areas may form a community on the basis of ethnic or racial origin, religious or political beliefs, occupation, friendship, or shared interests.

The term *community* has a different meaning in biology. Biologists define a community as a group of plants and animals living together in the same area and depending on one another. For example, scientists might study a desert or a swamp community. Joseph Bensman

Community college is an institution that offers additional training beyond high school. Community colleges, sometimes called junior colleges, offer a variety of programs. Most of the programs take two years to complete. Some students take the first two years of a program leading to a bachelor's degree. Others take technical education programs that prepare them for semiprofessional jobs. Still others take courses in what are usually called "adult education programs." Most community colleges also offer courses for students who need additional preparation in basic skills. Community and junior colleges grant associate's degrees for completion of two-year programs, and certificates for some specialized programs.

Most of the institutions called *community colleges* get financial support from local or state governments. Most of the institutions called *junior colleges* are privately supported.

The first junior colleges in the United States were established in the late 1800's. By 1900, eight private junior colleges were operating. Joliet Junior College, established in 1901 in Joliet, Illinois, is the oldest public junior college still in operation.

By 1950, there were about 600 community and junior colleges in the United States. More than half of the colleges operated as part of the local public school system and shared financial support with all other schools in the system. Many of them used high school classrooms and equipment and offered limited educational programs because they lacked sufficient funds. As businesses and industries began searching for better-educated people in the 1950's, many states and local communities increased their support of community and junior colleges. In the 1960's, from 30 to 50 new community and junior colleges were established each year. In the late 1990's, there were more than 1,100 community and junior colleges with about 9 million students in the United States.

How community colleges operate

Control and financing. Most of the two-year colleges in the United States are public institutions. That is, they receive funds from local or state governments, or both. Some state universities operate two-year branch campuses. A few community colleges operate as part of county or district school systems.

Some two-year colleges are private institutions. Some of these colleges receive financial support from church denominations. The rest of these colleges receive most of their funds from tuitions, fees, and contributions.

Community colleges began receiving federal aid in the 1960's. Federal funds help colleges in many ways. They may be used to build new buildings, or to set up vocational education or special education programs. Federal funds also provide loans and other financial aid to students.

Curriculum. Community colleges offer two main types of programs. In one program, students take courses designed to fulfill the first-year and sophomore requirements that lead to a bachelor's degree. These students must transfer from the community college to a college or university that grants bachelor's degrees to complete their junior and senior years.

In the second main program, community colleges offer specialized training for semiprofessional jobs in such fields as industry and engineering, health services, business, and public service. Students in industrial programs train for such jobs as drafting and laboratory work. Health programs train students for careers as nurses, X-ray technicians, or other medical workers. Business programs may include training in data processing, computer technology, and office management. Public service programs train students to become city planners, police officers, or other public employees.

Accrediting. Most two-year colleges are accredited by one of the six regional accrediting agencies recognized by the United States Department of Education. These same agencies accredit four-year colleges and universities. State boards of education also evaluate two-year colleges. Students attending two-year colleges approved by the state can easily transfer their credits to other colleges and universities approved by that state.

Faculty. Community colleges usually require teachers to have at least a master's degree. They prefer to hire teachers who would rather teach students in classrooms than conduct research in laboratories. Many community college teachers have taught in high schools, or in four-year colleges or universities. Some people without master's degrees are hired as community college teachers because they have had special training and experience.

Why community college?

Importance to students. One of the most attractive features of many community colleges is their wide range of technical training programs. Less than a third of the community college graduates continue their studies for bachelor's degrees. Special occupational programs allow students to take only those courses that interest them or that qualify them for better jobs.

Many community colleges have an "open-door" admissions policy. This policy allows students who might not qualify for admission to other colleges to continue their education.

Community colleges are often called "commuter colleges." Students within commuting distance may live at home and work at part-time jobs while they attend classes. Many community colleges have special programs for students who work during the day. The students may have classes until 10 or 11 p.m., or later. Evening classes are so popular that some community colleges have a larger number of evening students than they do day students. Some community colleges have established "weekend colleges" so that students can earn associate's degrees by attending classes on the weekends. The cost of attending most community colleges is relatively low.

Importance to community. Many community colleges try to provide educational programs that will benefit local business, industry, and government. They may conduct surveys to determine what types of trained personnel the community needs most. They may also ask community leaders to help plan courses. Some community colleges in large cities have special social and educational programs for disadvantaged minorities. Many community colleges stress programs for older adults, including job retraining and cultural development.

In many states, high school graduates who want to go to college enroll first in community colleges. Florida and some other states have established *upper-division universities,* which offer classes for both juniors and seniors. Upper-division universities are especially designed for students who have graduated from community college, but they are not limited to them.

Two-year colleges in Canada

Canada has about 200 two-year colleges and institutes. They are called regional colleges, institutes of technology, colleges for general academic and vocational education, or colleges of applied arts and technology. These colleges are organized much like U.S. community colleges. They offer job training and technical training programs, and academic programs like those that university students take during their first two years. Some programs take over two years to complete. The Canadian schools grant diplomas of technology or applied arts. They get funds from provincial or local governments, or both. Most of these colleges have been established since the early 1950's. Terry U. O'Banion

Community of Christ is a Christian denomination that originated in the 1830's. It bases its teachings on the Bible as well as the *Book of Mormon,* a narrative of God's dealing with early peoples of the Western Hemisphere; and the *Doctrine and Covenants,* a book of modern revelation and present-day church guidance. The denomination's mission is to proclaim Jesus Christ and promote communities of joy, hope, love, and peace.

The Community of Christ was founded in 1830 by Joseph Smith, Jr., as the Church of Christ, later known as the Church of Jesus Christ of Latter-day Saints. After Smith was killed in 1844, many of the denomination's leaders accepted Brigham Young, one of Smith's followers, as the new leader of the church. But some people believed that Smith designated his young son, Joseph Smith III, to be the next leader. They began to reorganize in the 1850's and were known as the Reorganized Church of Jesus Christ of Latter Day Saints from 1860 to 2001. In that year, the denomination changed its name to the Community of Christ to better reflect its mission.

Church presidents of the Community of Christ were all direct descendants of Joseph Smith, Jr., until 1996, when W. Grant McMurray became president. The denomination has congregations in more than 50 countries worldwide. Ordained male and female ministers and *lay* (nonordained) leaders serve the congregations. The Community of Christ has its international headquarters, which includes the main Temple, in Independence, Missouri. Critically reviewed by the Community of Christ

See also Mormons; Smith, Joseph.

Community property is the property husbands and wives own together under the laws of nine states—Arizona, California, Idaho, Louisiana, Nevada, New Mexico, Texas, Washington, and Wisconsin. The laws differ in detail, but they generally consider any property received through the efforts of a husband or his wife as the joint property of both. This property does not include gifts and legacies to only one or the other, or property that one of them owned before the marriage. When the husband or wife dies, half the property goes to the survivor. Only the other half of the property can be willed. In cases where couples divorce, most states require the husband and wife to divide community property evenly. Carlfred B. Broderick

Como, Lake. See Lake Como.

Comoros, *KAHM uh ROHZ,* is an *archipelago* (group of islands) in the Indian Ocean between the mainland of Africa and the island country of Madagascar. Comoros consists of three main islands—Anjouan, Grande Comore, and Mohéli—and several smaller islands. All the islands belonged to France until 1975. The Comoran government also considers the island of Mayotte part of the country, but the people of Mayotte have voted to remain a French possession.

The country's official name is Union of the Comoros.



M. Huet, Hoa-Qui

Moroni, the capital of Comoros, lies on the west coast of Grande Comore Island. Moroni is the country's largest city.

The islands, excluding Mayotte, have an area of 719 square miles (1,862 square kilometers). Mayotte has an area of 144 square miles (373 square kilometers). Moroni, on Grande Comore, is the capital and largest city.

Government. The Comoran Constitution, officially adopted in 2002, is intended to give greater autonomy to the country's three main islands. Each island elects its own president and its own parliament. Also, a national president is elected to a four-year term. This president comes from each of the three islands on a rotating basis. A prime minister, appointed by the president, heads the national government. Comoros has a 33-member national legislative assembly. The three islands' parliaments each appoint 5 members of the national assembly. The other 18 members are directly elected by the people.

People. Most people of Comoros have mixed ancestry. They are descendants of Arabs, black Africans, and others. About 85 percent of workers have jobs related to farming. But Comoros has a shortage of good farmland, and it must import much of its food. The chief food is rice. Most rice is imported. Other foods include bananas, cassava, coconuts, corn, fish, and sweet potatoes.

Major problems include poverty, disease, illness, hunger, and malnutrition. The nation has a shortage of physicians and hospitals. These problems contribute to a high death rate, especially among young children.

Most of the people of Comoros are Muslims. The country's official languages are Comorian and French, though most Comorans do not speak or write French.

Land and climate. Most of the Comoro Islands were formed by volcanoes. Mont Kartala, a volcano on Grande Comore, is still active. Plateaus and valleys lie below the volcanic peaks. Mangrove swamps form the shorelines of almost all the islands. Some of the islands have dense forests. However, much forestland has been cleared for farming. Such clearing has resulted in severe soil erosion on most of the islands.

Comoros has a cool, dry climate from May through October. A hot, rainy season lasts from November through April. Heavy rains during this period provide the islands with the only natural source of drinking water. The people store the water for year-round use.

Economy. Comoros is one of the world's poorest nations. It has no major industry, and no valuable minerals have been found there.

The economy of Comoros depends almost entirely on agriculture. The people raise such food crops as bananas, cassava, coconuts, and rice. They export cloves, *copra* (coconut meat), vanilla, and perfume oils from such plants as *ylang-ylang trees.* Money spent on imports has greatly exceeded earnings from exports. The country trades chiefly with France, Madagascar, Paki-

Comoros

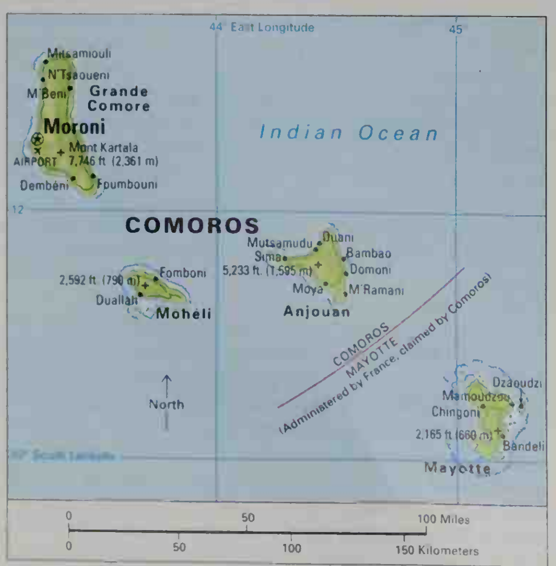
National capital

Settlement

Elevation above sea level

Road





WORLD BOOK maps

Facts in brief

Capital: Moroni.
Official language: Comorian and French.
Total land area: 719 mi² (1,862 km²). *Coastline*—243 mi (391 km). Area figures exclude Mayotte.
Elevation: *Highest*—Mont Kartala, 7,746 ft (2,361 m). *Lowest*—sea level.
Population: *Estimated 2002 population*—582,000; density, 809 per mi² (313 per km²), distribution, 71 percent rural, 29 percent urban. *1991 census*—446,817. Figures exclude Mayotte.
Chief products: bananas, cassava, cloves, coconuts, corn, perfume oil, rice, sweet potatoes, vanilla.
Flag: The flag has four horizontal stripes of yellow, white, red, and blue, and a green triangle. Inside the triangle are a white crescent and a vertical row of four white five-pointed stars. See Flag (picture: Flags of Africa).
Money: *Basic unit*—franc.

stan, and the United States. Comoros receives large amounts of financial aid from European and Arab nations. The country has an international airport—on Grande Comore—and several radio stations.

History. The first people to live in the Comoro Islands came from Africa, Madagascar, and Malaysia. Historians know little about them or when they came to the islands.

During the 1400's, Arabs landed on the Comoros and took over the islands. For the next 400 years, Arab sultans ruled each island as a separate kingdom.

France seized Mayotte in 1843 and by 1886 had gained control of the rest of the islands. The French granted the Comoro Islands self-rule in 1961.

In 1974, Anjouan, Grande Comore, and Mohéli voted for independence, but Mayotte voted to remain under French control. France recognized the independence of the three islands but rules Mayotte as a possession. In 1976, the people of Mayotte again voted for French rule.

Several Comoran governments held power for short periods after independence was declared. There have been a number of successful and unsuccessful coup attempts against the elected governments of Comoros. In 1997, separatists on Anjouan declared independence and set up an island government. Mohéli separatists also declared independence. Each group claimed the central government had neglected its island's political and economic needs.

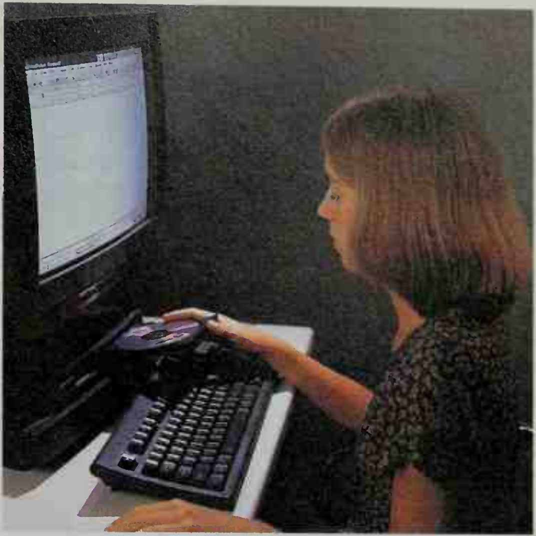
In April 1999, Grande Comore and Mohéli agreed to a peace plan designed to keep the islands unified but give each island greater autonomy. Anjouan did not agree to the plan. Later that month, military leaders led by Azali Assoumani overthrew Comoros's elected government.

In 2001, voters approved a new constitution designed to give greater autonomy to the three main islands of Comoros. In 2002, all three islands ratified the national constitution, approved their own local constitutions, and elected their own presidents. That same year, Azali was elected national president of Comoros. Leroy Vail

See also **Moroni**.

Compact disc is a round, flat platter on which recorded music, computer data, or other information is stored in the form of *digital* (numerical) code. The main use of compact discs (CD's) is to store recorded stereophonic music. Discs used for this purpose, called *Audio CD's,* are played on a *CD player.* The other major type of CD is called *CD-ROM (Compact Disc Read-Only Memory).* CD-ROM's can store files of text, pictures, sound, and other data, as well as video game programs and other software. These discs are played on a computer's *CD-ROM drive* or on a special *CD-ROM player.* Other types of CD's can store high-quality images or motion pictures.

CD's are made of hard plastic coated with thin metal, usually aluminum. CD's have only one playing side. A standard CD measures about 4 $\frac{3}{4}$ inches (120 millimeters) in diameter, with a $\frac{1}{2}$-inch (15-millimeter) center hole.



WORLD BOOK photo by Steven Spicer

A CD-ROM stores files of text, pictures, sound, and other data that can be viewed or played back using a computer's CD-ROM drive. A CD-ROM can hold as much text as hundreds of books.

Audio CD's

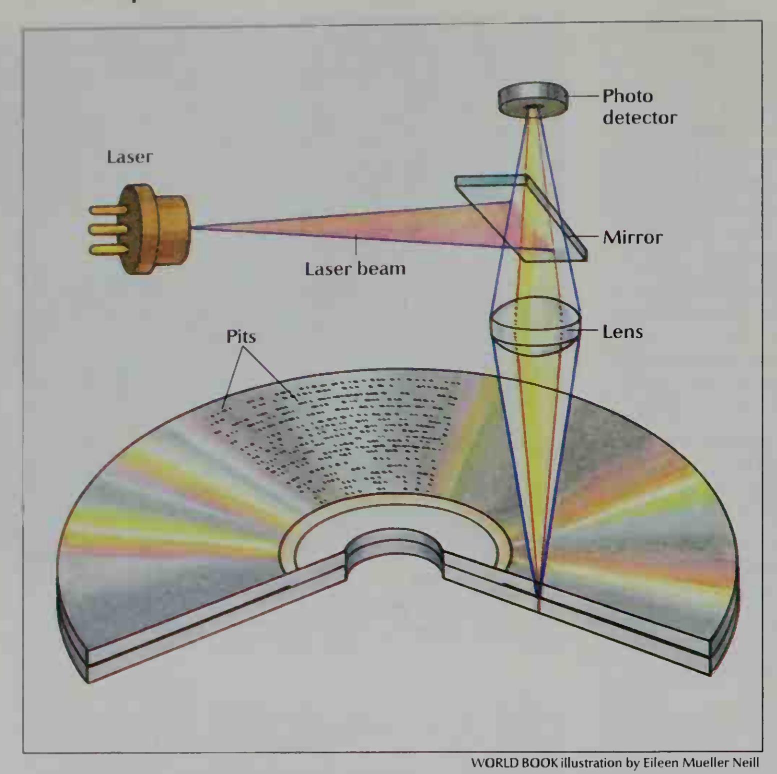
Audio CD's have three major advantages over cassette tapes: (1) they last longer, (2) they have superior sound quality, and (3) they enable the user to select any part of the recording quickly. Manufacturers have established an industry standard known as the *Red Book* so an Audio CD can be played on any CD player. One rule specifies how many minutes of sound each CD can hold. Other features, such as disc size and data format, are also standardized. Audio CD's were introduced in Japan and Europe in 1982, and in the United States in 1983. By the early 1990's, CD's had largely replaced long-playing (LP) records and had begun to outsell music cassettes.

Recording. During recording, a microphone translates sound waves into electric signals. A device called an *analog-to-digital converter* divides these signals into 44,100 segments, called *samples,* for each second of sound. It assigns to each sample a corresponding digital code. This code is expressed as a string of 16 electric pulses representing 1's and 0's. It represents any one of 65,536 sound values.

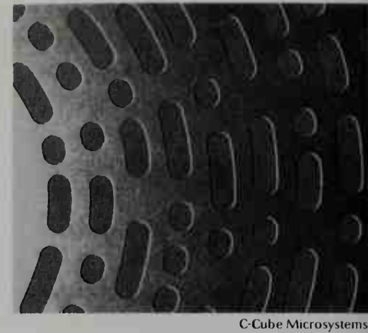
Manufacturing. A master tape made at a recording studio is sent to a CD manufacturing plant to make a master disc. A master disc begins as a glass disc coated with a *photoresist,* a chemical film that is eaten away when exposed to light. A laser exposes the photoresist in a spiral track, creating microscopic pits that represent the digital data on the tape. Pits are about $\frac{1}{42,000}$ inch (0.6 micrometer) wide. Depending on playing time, a pit spiral might contain more than 2 billion pits. If unwound, this spiral would stretch about 3 miles (5 kilometers).

The master disc is used to make metal copies. These copies are then used as molds to make individual discs. Plastic is fed into a molding machine, melted, and injected into a mold to create clear discs. These discs are then coated with a metal layer and a protective plastic layer. A label is usually printed directly on this plastic layer. A sophisticated manufacturing system can produce one CD every few seconds.

Playback. As the CD spins inside a CD player, a laser beam shines through the plastic on the underside of the disc and follows the pit spiral. The metal coating reflects the laser beam. The intensity of the reflection changes as the beam enters and leaves a pit. A device that is called a *digital-to-analog converter* translates the reflected

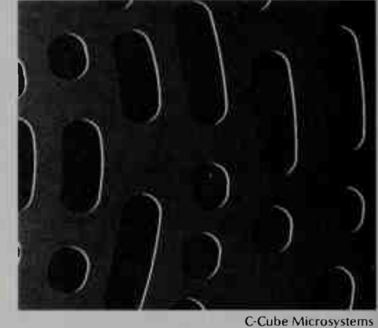


WORLD BOOK illustration by Eileen Mueller Neill



C-Cube Microsystems

DVD pits



C-Cube Microsystems

Ordinary CD pits

A DVD contains layers of digital data encoded in tiny pits. In a DVD player, a lens focuses a laser beam on the desired layer. As the disc rotates, the pits and the flat areas between them reflect patterns of light to a photo detector, which changes the patterns into electrical signals. A single layer of a DVD has more pits, placed closer together, than an ordinary CD has, and so can store more data.

light into an electric signal, which is used to produce sound. Because information on the disc is read by a light beam, playing a CD causes no more wear to the recording than reading causes to words printed on paper.

CD players are available for home, car, or portable use. A CD player enables the user to play an entire disc or selected *tracks* (recordings) on the disc. Fast-forward and reverse controls make it possible to find passages within a track. Other controls let the listener repeat tracks, play tracks in random order, and program specific sequences of tracks. A *CD changer* enables the user to load several discs at once for an extended period of play. Most changers hold 6 to 10 discs, and some hold 100 or more discs.

CD-ROM's

CD-ROM's are created and used in much the same way as Audio CD's. In the CD-ROM drive, a light-sensitive device produces a digital electronic signal. Circuits process this signal and send it to a computer or special player. The *Yellow Book* standard regulates CD-ROM's. A CD-ROM can hold about 650 *megabytes* (million bytes) of data. One byte equals a letter or other character. One CD-ROM can hold the text of many books. The phrase *read-only memory* means that CD-ROM's store data permanently and cannot be altered by the user.

Many CD-ROM's store mainly textual information and software programs. Other types of CD-ROM's include *multimedia CD's* and *picture CD's*. Multimedia CD's contain a combination of text, graphics, sound, photographs, motion pictures, and other types of media. A person using a multimedia CD-ROM might "tour" a museum on a computer monitor, viewing and listening to the exhibits. Other multimedia CD-ROM's contain encyclopedias, stories, and video games.

A picture CD can store photographs taken with an ordinary camera. Many photo shops can arrange for photographs to be transferred from negatives or slides to a picture CD. Consumers can use CD-ROM drives to view the pictures on a computer monitor. A picture CD stores no sound information.

Other formats

DVD's are a type of read-only memory compact disc. A DVD is the same size as a CD but has huge storage capabilities. A DVD stores data on one or both sides. Each side of the disc can contain two data layers, one embedded beneath the other. A DVD can hold up to 17 *gigabytes* (billion bytes) of information on both sides. According to most DVD manufacturers, the letters *DVD* have no specific meaning.

The DVD requires a special drive, which can also play CD-ROM's and audio CD's. A DVD drive can read data at a much faster rate than a typical CD-ROM drive. The DVD format appeared in 1996.

Video CD's store digital video and audio signals. A 74-minute full-motion, full-color video program with stereo sound can be stored on one disc. The *White Book* standardizes Video CD's. A Video CD player or DVD player is connected to a television and stereo sys-

tem to view the program. The Video CD format was introduced in 1994.

CD-R *(Compact Disc-Recordable)* is a format that enables a user to record permanent information. The CD-R format is standardized in the *Orange Book.* A blank disc can hold as much data as a CD-ROM, and it can be recorded with music or other data. However, once recorded, the CD-R disc cannot be erased.

The CD-R format uses a recording method known as *dye-polymer.* An organic dye recording material is sandwiched between the plastic disc and top metal layer. During recording, a high-power laser beam hits the recording layer, storing information in patterns of tiny pits. The disc can be played back on a regular CD player. CD-R's are often used to make small quantities of discs that would not be economical for a CD manufacturing plant to produce. CD-R's are also popular with music fans who compile discs with their choice of tracks.

CD-RW *(Compact Disc-ReWritable)* is a format that enables a user to record, erase, and re-record such information as music and data. The format is standardized in the *Orange Book.* A blank disc holds as much data as a standard CD-ROM disc. Only newer, more sensitive players can read a CD-RW disc.

CD-RW format stores information using a method called *phase-change recording.* The recording layer of a CD-RW disc is made of a material with reversible properties. On a blank disc, this layer is in a crystalline state. During recording, a high-power *writing laser* emits intense heat on tiny, select areas of the recording layer. These areas change to an *amorphous* (noncrystallized) state. Unheated areas remain in their crystalline state. Like the pits on a standard CD, the amorphous marks reflect less light than the crystalline areas. A CD-RW is read by reflecting a low-power *reading laser* off the spiral track on the disc's surface to a converter that detects the difference between light reflected by the crystalline and amorphous areas. To erase all or part of a disc, a CD-RW drive uses a medium-power laser to heat the recording layer and return it to a crystalline state. Users can write and erase data at least a thousand times.

Minidiscs (MD's) measure only $2\frac{1}{2}$ inches (6.4 centimeters) across and are contained in a flat plastic cartridge. A person can record up to 74 minutes of sound on some MD's and later erase the sound and record on the disc again. Other MD's are for playback only. The MD format is different from the CD format, so MD's require a special recorder/player. MD units are available for home, car, and portable listening.

Recordable MD's use a method called *magneto-optical recording.* During recording, a magnetic layer is momentarily heated by a high-power laser beam. The digital data are magnetically stored in the layer as it quickly cools. The data can be erased by reheating the layer and writing new data. The minidisc format was introduced in 1992. Ken C. Pohlmann

Related articles in *World Book* include:

Computer (Storage devices)
Computerized instruction (How computerized instruction works)
Digital technology
DVD
Electronic publishing
Laser (Recording, storing, and transmitting information)
Multimedia
Stereophonic sound system (Program sources)
Video game

Comparative psychology is the study of differences and similarities in the behavior of animals of different species. Comparative psychologists may analyze a single activity as it occurs in a large number of species. For example, they may examine the raising of young among birds, whales, tigers, and other animals. They also may study the complete behavioral pattern of two or more related species. For instance, they may compare the feeding, mating, and other activities of two desert rodents, the kangaroo rat of North America and the jerboa of Africa.

Some of the principal behavioral patterns of animals that comparative psychologists study include communication, learning, migration, orientation, reproductive behavior, and social behavior. *Communication* is the sharing of information among animals. *Learning* concerns the gaining of knowledge or skill. *Migration* is the travel of large groups of animals. *Orientation* consists of the ways that animals position themselves in relation to light, heat, and other forces. *Reproductive behavior* concerns the mating habits of animals and the ways they care for their young. *Social behavior* consists of group activities, such as the flocking of birds.

Comparative psychologists observe animals in their natural environment and in controlled conditions in laboratories and zoos. In both types of surroundings, researchers use methods that enable them to observe behavior while interfering as little as possible with the creatures' activities. For example, psychologists may attach electronic devices to the animals. The devices send signals pinpointing their location or relay information on blood pressure, temperature, and other body functions. In the laboratory, researchers may observe animal behavior from behind one-way mirrors. In the wild, they may watch from inside camouflaged enclosures.

Comparative psychologists may record animal behavior on paper using code symbols for various types of behavior. They also film and tape-record certain activities. In addition, they may arrange for an animal to record data itself. For example, many experimenters use a device called a *Skinner box*, where an animal must op-



WORLD BOOK photo by Kevin Walsh

A test of color recognition requires a monkey to choose between different-colored objects to be given a reward, such as food. Comparative psychologists study the behavioral patterns of animals of different species.

erate a switch or other mechanism to obtain a reward. The switch also activates a recording device.

Comparative psychologists, like other scientists, employ various statistical methods in their work. They often use computers to analyze large amounts of information.

Ethel Tobach

Comparison, in grammar, is the inflection of some adjectives and adverbs to express a greater or smaller degree of the quality the word denotes. *Inflection* means changing the form of a word.

The three degrees of comparison are the positive, comparative, and superlative. The *positive* is the simple degree, as in, "This book is *heavy*"; "This book is *interesting*." The corresponding adverbs, *heavily* and *interestingly,* are also in the positive.

The *comparative* is used when two objects are being compared, as in, "This book is *heavier* (or *less heavy)* than the other," or, "*more interesting* (or *less interesting)* than the other." The corresponding adverbial forms, such as *more heavily* and *less interestingly,* are also in the comparative degree.

The *superlative* is used to point out the one among three or more objects that has the highest or lowest degree of the quality referred to: "This is the *heaviest* (or *least heavy)* book," or "the *most interesting* (or *least interesting)* book." The corresponding adverbial forms, such as *least heavily* and *most interestingly,* are also in the superlative degree. The superlative is also used in the intensive sense of *very,* without implying comparison, as in "That is *most attractive*."

Regularly compared adjectives add the suffixes *-er* and *-est* to the positive form, as in *proud, prouder, proudest.* This change is described as *comparison by inflection.* If the adverbs *more, most, less,* or *least* are prefixed, the change is described as a *periphrastic comparison,* as in *proud, more proud, most proud.*

Irregularly compared adjectives include some of the most common adjectives in English—words that have come down from Old English, or Anglo-Saxon, forms. The following list contains some irregularly compared adjectives.

Positive	Comparative	Superlative
bad	worse	worst
far	farther	farthest
good, well	better	best
little	less	least
old	older, elder	oldest, eldest

Some adjectives and adverbs, such as *perpendicular, square, eternal, unique,* and *perfect* may be considered absolute in meaning and therefore not subject to comparison. If *unique* means "having no equal," how can something be *more unique?* However, phrases like *more perfect, rounder,* and *yellowest* are commonly used. More precise phrases would be *more closely perfect, more nearly round,* and *most intensely yellow.*

The words *other* and *else* are often used to distinguish the elements that are being compared. For example, if Robert's height is being compared with that of the other boys in his class, a precise phrasing would read: "Robert is taller than *any other boy* (or *anybody else)* in his class," not "Robert is taller than *any boy* (or *anybody)* in his class."

Usage. When two objects are compared, the comparative form is used, not the superlative. "Helen is the *healthier* of the twins" is correct. "Helen is the *healthiest* of the twins" is wrong. When comparison is made by inflection, adding an adverb is unnecessary. *Happier* is an adequate comparison. *More happier* is not standard usage.

Sara Garnes

See also **Adjective; Adverb; Inflection.**

Compass is a device for determining direction. The simplest form of the compass is a magnetized needle mounted on a pivot so that it can turn freely. The needle aligns itself with the earth's magnetic field and points roughly toward the North Pole. Under the needle is a circular *compass card,* on which evenly spaced *points* and degrees are marked to indicate direction. The four *cardinal points* of the compass are north, east, south, and west. Midway between these points are northeast, southeast, southwest, and northwest, called the *intercardinal points.*

Large compasses are also marked, clockwise, with the 360 degrees of a circle. North corresponds to 0 or 360 degrees, northeast to 45 degrees, east to 90 degrees, southeast to 135 degrees, south to 180 degrees, southwest to 225 degrees, west to 270 degrees, and northwest to 315 degrees.

A simple pocket compass helps people find their way when there are no landmarks to guide them. For example, if a person must walk west to reach the nearest town, he or she lines up the needle so that its ends are over the north and south marks on the compass card. The person then travels in the direction 90 degrees to the left of the north end of the compass needle.

A *mariner's compass* is a magnetic compass used aboard a boat or ship. In most cases, the magnetized needle is fastened on the underside of a compass card. The card rests on a pivot so it can turn freely inside the compass bowl and can always point toward the magnetic pole. The compass bowl has a transparent cover and is filled with a liquid mixture of alcohol and water or glycerin and water. This mixture floats the card and at the same time *damps* (slows) the movement of the card so that it does not constantly swing from side to side with the motion of the ship.

Variation. The earth has two poles known as the *true North and South poles.* The true poles are the "top" and "bottom" of the earth, where the earth's spin axis penetrates the earth's surface. The magnetic poles do not lie at the true North and South poles. They are shifting points on the earth's surface, several hundred miles or kilometers from the true poles.

The angle between the direction of the magnetic pole and the true North or South poles at any location is called *variation* or *declination.* The variation of a compass is different at different places on the earth. The variation also changes slightly at differ-



WORLD BOOK photo by Ralph Brunke

A pocket compass has a magnetic needle that points north. A pocket compass helps people find their way when there are no landmarks to guide them.

ent times of the year and in different years. Thus, to use a magnetic compass accurately, a person must know the amount of variation at his or her location and what variation correction must be made in reading the compass. This information about the variation appears on all mariners' charts and on many maps.

Deviation. If a magnetic compass is placed close to a metal object that contains iron, it will be drawn toward that object. The angle formed between the magnetic pole and the direction the compass points is known as *deviation.*

When a mariner's compass is installed on a ship, it is mounted in *gimbals* (supporting rings that pivot) often in a stand called a *binnacle.* The binnacle has magnetic devices that cancel out deviation caused by the metal and other magnetic influences of the ship itself. The navigator then *swings the ship.* That is, he or she heads the ship in different directions, checking the direction by a known landmark. For each of 24 points of direction—that is, every 15 degrees around a complete circle—the navigator notes how many degrees of deviation the compass shows from the true direction. For example, by checking a landmark, a navigator may know that the ship is heading exactly east. But after he or she has corrected the compass reading for variation, the compass may indicate the ship is heading two degrees south of east. Thus, to head directly east when the ship is out of sight of land, the navigator will steer a course two degrees south of east on the compass, after correcting for variation. The navigator may also check direction using a *gyrocompass,* which always points toward true north. Many pleasure boaters check deviation for only 12 points of direction—that is, every 30 degrees.

Some automobiles are equipped with a digital electronic compass. Such a compass uses an oscillating electronic circuit that is affected by the earth's magnetic field to determine the direction of the field. After a digital electronic compass is installed, it must be adjusted to cancel out deviation caused by metals or other magnetic influences in the automobile itself. Many digital electronic compasses can also detect and automatically compensate for distortions in the magnetic field. Such a distortion may occur when, for example, the vehicle crosses a metal bridge.

History. Chinese and Mediterranean navigators probably first used magnetic compasses to guide their ships in about the 1000's or 1100's. These compasses were simple pieces of magnetic iron, usually floated on straw or cork in a bowl of water. In about the 1300's, the compass card was marked off into 32 points of direction. During the following years, navigators learned more about deviation or variation of compasses in various parts of the world, and came to use magnetic compasses with greater accuracy.

When iron and steel vessels appeared in the late 1800's, it became more difficult to make accurate magnetic compass readings aboard a ship. The metal of the ships affected the readings. As a result, inventors developed the gyrocompass, which is not affected by magnetism and points toward true north.

Large ships and aircraft today carry both magnetic compasses and gyrocompasses. In the 1940's and 1950's, scientists developed special gyroscopes for compasses used in the polar regions. In addition to a compass, many ships and aircraft use a satellite network called the Global Positioning System to aid in navigation (see Global Positioning System). Debora M. Katz

Related articles in *World Book* include:

Gyrocompass	Magnetism
Invention (picture: The magnetic compass)	Navigation
	North Pole
Lodestone	South Pole

Compass plant is a coarse plant that grows in the Midwestern United States. It reaches a height of 10 feet (3 meters) and is covered with short, rough, hairlike parts. The leaves are about 1 ½ feet (46 centimeters) long and cut into several lobes. The lower leaves of the compass plant tend to line up edgewise in a north-south direction. In this way, the leaves escape the strong midday sun, but get the full early morning and late afternoon sunlight. The compass plant is known as the *pilotweed* in some Midwestern States. Robert A. Kennedy



WORLD BOOK illustration by Robert Hynes

The yellow flower heads of the compass plant look like sunflowers. This coarse plant grows 10 feet (3 meters) tall.

Scientific classification. The compass plant belongs to the composite family, Asteraceae or Compositae. The scientific name for the compass plant is *Silphium laciniatum.*

Competency-based education refers to educational programs that require students to master certain skills or objectives. These skills or objectives are called *competencies.*

In competency-based education, also known as CBE, groups of teachers, parents, and school administrators often work together to select the competencies. For example, they may decide to make the ability to distinguish fact from opinion one competency for a fourth-grade reading program.

Schools may use several kinds of CBE programs. One kind focuses on the basic skills of reading, writing, and arithmetic. Another kind involves basic skills and such practical skills as balancing a checkbook or completing an income tax form. In most CBE programs, students take *minimum competency tests* to determine how well

they have learned the chosen skills. Some CBE programs require high school seniors to pass such tests before they may graduate.

Many educators believe CBE has several advantages over other programs. They feel that students work harder when given a clear set of goals. CBE programs can also increase the likelihood that students will master certain skills. CBE tests can help teachers identify learning difficulties. As a result of CBE, some state governments have provided additional funds for *remedial programs.* These programs give special help to students who have difficulty mastering the competencies.

Critics of competency-based education fear that some students may not receive adequate preparation for the tests. These students may get discouraged and drop out of school. Some critics also believe that CBE remedial programs have no lasting effect. Ronald K. Hambleton

See also **Education** (What should be taught; How can performance be improved); **Curriculum** (Curriculum changes); **Teaching** (The effectiveness of teacher training).

Competition, in economics. See **Monopoly and competition.**

Composer is a person who writes music. A composer creates a musical composition by arranging the elements of music in a meaningful order. These elements include harmony, melody, rhythm, tone, and *timbre* (tone color).

The role of the composer has varied greatly throughout history. For example, composers in the 1300's worked either for the church or for noble or royal patrons. By the 1600's, however, composers were also writing music for public concerts. Composers in the 1600's often performed their music as well. However, during the late 1700's and the 1800's, conductors and *virtuosos* (highly skilled performers) became important in presenting music to large audiences. Most composers mainly provided music for others to interpret in performance. During the 1900's, composers began to write music for motion pictures. Today, universities employ many composers to teach composition as well as to compose.

During the 1900's, the development of electronic music and *aleatory music* offered new possibilities for the performance of a composer's work. For a discussion of these types of music, see **Aleatory music** and **Electronic music.** Thomas W. Tunks

See also **Classical music** and its list of *Related articles* on composers.

Composers, Authors and Publishers, American Society of. See **American Society of Composers, Authors and Publishers.**

Composite family, *kuhm PAHZ iht,* is the common name for a large family of flowering plants. The scientific name for this family is Asteraceae or Compositae. The family consists of more than 20,000 species of herbs and shrubs. These plants are found throughout the world and in most climates and habitats. The composite family includes such familiar plants as asters, daisies, goldenrods, lettuce, ragweeds, sagebrush, thistles, and zinnias.

In plants of the composite family, each flower head is a composite of many small flowers surrounded by a cuplike cluster of modified leaves called *bracts.* From a distance, the flower head resembles a single large flower. A daisy, for example, has an outer ring of long, white *ray flowers* that look like individual petals, and a yellow center of many tightly packed, tube-shaped *disk flowers.* A thistle head has only disk flowers, and all the flowers of a dandelion head are raylike.

Some plants of the composite family, including endive, chicory, lettuce, and artichoke, are used as food by human beings. The seeds of sunflowers and safflowers are important sources of vegetable oils. Calendula, camomile, wormwood, tansy, and arnica are used to make drugs. Chrysanthemums, asters, dahlias, and many others are grown for their beauty. David J. Keil

See also **Flower** (Variations in flower structure).

Each plant mentioned in this article has a separate article in *World Book.*

Composite materials are solid substances made up of at least two distinct ingredients, one embedded within the other. The embedded material, called the *reinforcement,* gives strength to the composite. The surrounding material, called the *matrix,* holds the composite together and gives it shape. A composite may include more than one reinforcement.

Reinforcements may be fibers or *particulates* (tiny particles). Fibers may be long or short, and they may be in single strands; bunched or matted together; or woven, knitted, or braided. Reinforcements are manufactured from such materials as boron, carbon, ceramics, glass, and plastics. The matrix is a solid body with adhesive properties. Common matrix materials include *synthetic resins* (chemical compounds used to make plastic products), glass, ceramics, and various metals.

Engineers use various combinations of reinforcement materials, forms of reinforcement, and matrix materials to produce composites with specific *properties* (characteristics). The ability of composites to satisfy special requirements gives them an important advantage over raw materials whose properties cannot be changed chemically. This ability enables engineers to develop, for example, a material that meets specific requirements for both weight and resistance to corrosion.

Polymer composites. The most widely used composites consist of fibers in a *polymer matrix*—that is, a matrix of synthetic resins. Synthetic resins are made up of long chains of molecules called *polymers.* Such composites include glass-fiber reinforcement in a polyester matrix and graphite fibers in an epoxy matrix. Carbon and epoxy form a strong, lightweight composite that is used to make tennis rackets, fishing rods, golf clubs, bicycle frames, and other sports equipment. Polymer composites are also used to make parts for aircraft, automobiles, high-speed trains, boat hulls, medical appliances, and industrial machinery.

Manufacturers produce polymer composite parts in several ways. For example, they may mix short fibers with a polymer liquid and squirt the mixture under pressure into a mold called a *die.* Or they may place mats of reinforcement in a die and fill the cavity with liquid resin, which solidifies around the mats. Tough composite parts may use braided *filaments* (continuous fibers) as the reinforcement. Or they may be manufactured using *filament winding,* in which the fibers are coated with a polymer and wound around a rotating cylinder called a *mandrel* to create a hollow structure. The mandrel is removed after the polymer solidifies.

Hybrid composites combine different fibers—such

as carbon and *aramid,* a type of synthetic fiber—in the same matrix. Engineers can vary the length and orientation of the fibers in different regions of a product. For example, they can use expensive, high-strength fibers in critical regions and cheaper, lower-strength fibers in regions that will experience little stress.

Other composites. Manufacturers make some automobile engines and parts for racing bicycles from metal-matrix composites. Ceramic-matrix composites are used to make some cutting tools. Brian S. Thompson

See also Materials.

Composition, in writing, is putting together words to express thought. The word *composition* may refer either to the process of creating a piece of writing or to the piece itself. As a school assignment, a composition is sometimes called a *theme* or an *essay.* The process of composing involves gathering and arranging information and opinions to express a point of view. A composition is an expression of a writer's personality.

Preparing a composition may help you to sharpen your ideas and present your thoughts so that others can understand them. The ability to write clearly and effectively is important to success in school and in many types of jobs.

Settling on a subject is the first step in preparing your composition. Your teacher may assign you a topic or you may choose your own. If you are choosing your own subject, begin by selecting a topic that interests you, or about which you have some knowledge. Reading about your topic may help you develop your ideas. Avoid topics that are too broad or too general to be discussed fully in the limited space of your composition. On the other hand, avoid a topic that is too narrow to be discussed in a complete and satisfying way.

Beginning your composition. Some writers begin composing by jotting down a list, in no particular order, of things they might want to say about a subject. Other writers take notes for a certain period of time. Most experienced writers revise and refine their first efforts over and over. As they revise, they add new information, eliminate unnecessary material, rearrange the order of presentation, and focus on their most important ideas. Inexperienced writers often make a major mistake by skipping the revision steps and starting to write the finished composition before they are ready.

Organizing your thinking. No writer can say everything possible about a subject. Writers must choose the points they want to focus on, then organize the material in a way that presents their ideas effectively. You can choose from many patterns of organization in planning your composition. You may find it desirable to combine two or more patterns. Your order will be determined by what you want to say.

For example, you might begin your composition with a general statement, called a *thesis,* and proceed to examples or details that support or clarify that thesis. You can also begin with specific points and work toward a general principle that explains them. You may argue from the result of something to its causes, or from its causes to its result. You may develop an argument by contrasting your own position with opposing arguments. If your composition describes something, you may lead up to your strongest impression or begin with that impression and make connections to other impressions or ideas. Some stories and processes are best described as they unfold in their natural time sequence.

After you have selected a strategy for organizing and presenting your ideas, you should develop an outline. An outline serves as a detailed blueprint for your composition. For more information about how to construct an outline, see Outline.

Writing your composition. After organizing your ideas and developing an outline, you are ready to write your composition. Writing a composition should always be a process of rewriting. Your finished composition should go through several versions called *drafts.* For the first draft, try to write your composition from beginning to end at a single sitting. In this initial version, do not be concerned about sentence patterns, spelling, or grammar. Write on every other line of the paper or double-space if you are typing or using a computer so that you can easily revise this draft.

In a second session, review your draft, establishing the proper relationships between ideas, words, phrases, clauses, and sentences. Put yourself in the reader's place and ask yourself, do the ideas make sense? Are they illustrated with concrete and interesting examples? Make necessary corrections and revisions right on the draft. Pay particular attention to such linking words as *when, thus, but, so, for example,* and *on the other hand.* Such connecting words are signposts for your reader and are more important than filling a composition with colorful adjectives or long, impressive-sounding words. Plan to rewrite your draft as many times as you need to make the argument of your composition clear and forceful.

Your final editing. As the last step in composing, review your text carefully. Check your spelling, punctuation, and capitalization, and make certain you are using correct grammar. Finally, print out, type, or write your composition on clean paper. Be sure to follow exactly any directions your teacher has provided on preparing the final copy. Harold Patrick Brent

Related articles. See *A Student Guide to Better Writing, Speaking, and Research Skills* in the Research Guide/Index Volume 22. See also:

Capitalization	Punctuation	Spelling
Grammar	Sentence	Vocabulary
Outline		

Compost is a kind of soil conditioner made from partly decayed plant material. Gardeners mix it with the soil to loosen the structure of the soil. Most compost also provides *nutrients* (nourishing substances) to the soil. Compost may also be used as a *mulch*—that is, spread on top of the soil to keep moisture in (see Mulch).

Compost is made by placing dead plant parts in a pile and allowing them to decay. Grass and garden clippings, leaves, and coffee grounds are the materials most commonly used, but any plant material is suitable. These materials are packed in layers about 6 inches (15 centimeters) deep. After each layer, a thin layer of manure or soil is usually added to speed decay. Watering the mixture also speeds decay. If a container is used for the compost pile, its walls should allow some air to enter. The compost should decay for five to seven months before it is used. Taylor J. Johnston

See also Gardening (diagram: A compost pile).

Compound is a substance that contains more than one kind of atom. Every compound has a definite com-

position that can be described by a chemical formula. For example, water is a compound that contains two kinds of atoms, hydrogen (H) and oxygen (O). Water's chemical formula is written H_2O because there are exactly twice as many hydrogen atoms as oxygen atoms in any sample of water. Other familiar compounds include salt and sugar. These compounds and numerous others occur in nature. Many other compounds are artificially created.

There are more than 100 chemical elements. The atoms in one element are different from those in any other element. The atoms combine in many ways to form millions of compounds. In some cases, atoms of the same elements combine in different proportions to produce a large number of compounds. For example, atoms of carbon and hydrogen can combine to form methane (CH_4), which is the main component in natural gas. These same elements also form propane (C_3H_8), which is used as a fuel for torches and camping stoves. There are thousands of other compounds that contain only carbon and hydrogen.

Each compound has its own distinctive properties. Compounds may be solids, liquids, or gases. They also may have a variety of colors. Some compounds will readily undergo a chemical reaction, but others have little tendency to react.

Compounds can be divided into two groups. *Organic compounds* contain carbon atoms. Proteins, fats, carbohydrates, nucleic acids, and many other compounds in living things are organic compounds. All other compounds are called *inorganic compounds.*

Many substances that contain atoms from more than one element are *mixtures,* not compounds. A compound always has the same composition by weight. But the composition of a mixture is not fixed and varies from sample to sample. For example, chocolate chip ice cream is a mixture. Its composition varies, and some samples contain more chocolate chips than others.

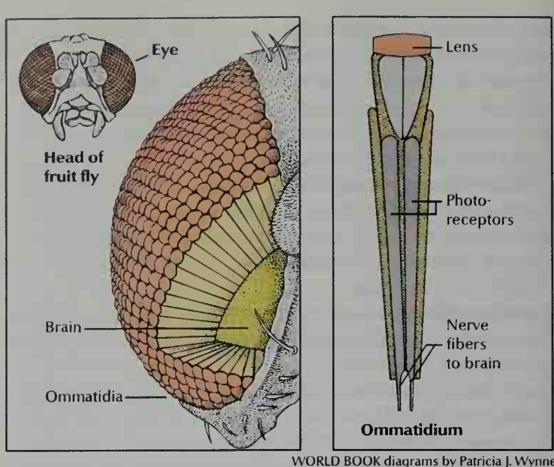
Chemists prepare compounds in several ways. Some compounds are formed by combining elements. The properties of a compound differ from those of the elements from which it was made. For example, the elements sodium and chlorine combine to form the compound sodium chloride, or table salt. Sodium is a soft metal that reacts violently with water and other substances. Chlorine is a yellowish gas that is poisonous. In contrast, sodium chloride is a hard, unreactive, white, crystalline solid.

Compounds can also be made from other compounds. Living things have the ability to add compounds together to form more complex compounds, and to break down compounds into simpler substances. In addition, many compounds break up into simpler compounds or elements when they are heated to high temperatures or exposed to electricity. Ronald C. Johnson

Related articles. See Chemistry and its list of *Related articles* on specific chemical compounds. See also:

Acid	Chemical reaction	Molecule
Atom	Element, Chemical	Radical
Base	Isomers	Salt, Chemical

Compound eye is a type of eye that has many tiny lenses close together. Compound eyes differ from eyes that have only one lens, such as those of fish, birds, and mammals, including human beings. Two large groups of animals have compound eyes—insects and *crustaceans,* which include crabs and lobsters.



The compound eye of a fruit fly, *left,* is made up of structures called *ommatidia.* Each ommatidium, *right,* has a lens that lies on top of light-sensitive cells called *photoreceptors.*

The number of lenses in a compound eye varies from fewer than 100 to more than 20,000 among different species of animals. Each lens is the top part of a structure called an *ommatidium.* Beneath the lens, an ommatidium consists of many light-sensitive cells called *photoreceptors,* each of which is connected to the brain by a nerve.

The surface of a compound eye is curved. As a result, no two ommatidia face exactly the same direction. Each ommatidium registers an impression of a small part of the animal's surroundings. A single ommatidium does not produce clear images of objects. Instead, the impressions from all the ommatidia form a "mosaic," from which the animal's brain distinguishes patterns of light and color. A compound eye has no mechanism for focusing, and so only nearby objects can be seen sharply. However, a compound eye is ideal for detecting motion because even the slightest movement causes a different image to fall on each ommatidium.

Many species of insects have compound eyes that can see ultraviolet light as a distinct color. The human eye cannot do this. Similarly, certain insects can detect the plane of polarization in polarized light, an ability that the human eye lacks (see **Polarized light**). The ability to detect the plane of polarization helps such insects as ants and bees to navigate by using the sun, because the polarization of sunlight varies according to the sun's position in the sky. Timothy H. Goldsmith

See also **Insect** (Sight; picture); **Ant** (Sense organs).

Comprehensive Test Ban Treaty. See **Arms control** (History of arms control).

Compression. See **Gasoline engine** (High and low compression); **Rotary engine.**

Compromise of 1850 was a series of acts passed in 1850, by which the United States Congress hoped to settle the strife between opponents of slavery in the North and slaveowners in the South. These laws helped delay civil war for about 10 years.

The main problem was whether the territory the United States received as a result of the Mexican War

(1846-1848) should have slavery. As part of the Compromise, California entered the Union without slavery. The territories of New Mexico and Utah were organized, but the slavery question was left to the settlers in each territory to decide. To satisfy the South, the Compromise gave Texas $10 million to abandon its claims to New Mexican territory and give up other claims. The Compromise also set up a stricter federal law for the return of runaway slaves. To please the North, the slave trade was abolished in the District of Columbia.

Daniel Webster, Henry Clay, and Stephen A. Douglas led in winning the passage of the Compromise laws. John C. Calhoun led Southern opposition to the laws. For a few years, the Compromise seemed to have ended the friction. Business people wanted peace so prosperity would continue. But many Northerners thought the Fugitive Slave Law was too harsh, and some states interfered with its enforcement. Slaves continued to escape to Canada by the *underground railroad.* However, slavery did not become a major issue again until the Kansas-Nebraska Act of 1854 made slavery legal in those territories where it had been prohibited by the Missouri Compromise in 1820. Robert F. Dalzell, Jr.

Related articles in *World Book* include:

Fugitive slave laws
Kansas-Nebraska Act
Omnibus bill
Underground railroad
United States, History of the
(picture: The Compromise of 1850)

Compsognathus, *kahmp SAHG nuh thuhs,* was one of the smallest known dinosaurs. It grew to about the size of a chicken or turkey, measuring around $2\frac{1}{2}$ feet (0.8 meter) long and weighing approximately 6 to 7 pounds (2.7 to 3.2 kilograms). The animal lived from 155 million to 145 million years ago, during the Late Jurassic Period.

Compsognathus had a light but powerful body with long legs, birdlike feet, and short arms. Two fingers on each hand ended in powerful claws. The dinosaur was an agile creature that could run quickly on its hind legs, using its long tail to provide balance. *Compsognathus* also had an elongated, flexible neck and a narrow, pointed head. Its name means *elegant jaw* in Greek. Like modern birds, *Compsognathus* possessed hollow bones.

Compsognathus lived in what is now Europe, probably inhabiting coastal environments around lagoons. It hunted and ate insects, lizards, and small mammals. Scientists found the remains of a small lizard in the stomach area of a *Compsognathus* skeleton.

David B. Weishampel

See also **Dinosaur** (picture: When dinosaurs lived).

Compton-Burnett, Ivy (1884-1969), an English novelist, ranks among the most accomplished literary stylists of her time. In achieving style, she largely ignored description, plot, and exciting action. Instead, she used highly polished dialogue to reveal the essential nature and inner thoughts of her characters. All her characters speak brilliantly—whether they are adults or children, masters or servants. Many of her books center around intricate family relationships. They are all set in the late Victorian upper-class atmosphere in which Compton-Burnett was raised. Her novels include *Bullivant and the Lambs* (1948), *Mother and Son* (1955), and *The Mighty and Their Fall* (1962).

Compton-Burnett was born June 5, 1884, in London. Queen Elizabeth II made her a Dame Commander in the Order of the British Empire in 1967, and she became known as Dame Ivy Compton-Burnett. Jane Marcus

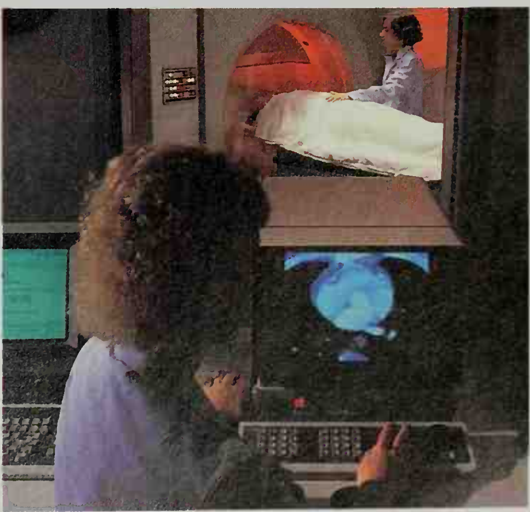
Computed tomography (CT), *tuh MAHG ruh fee,* is an X-ray system used to produce images of various parts of the body, such as the head, chest, and abdomen. Doctors use CT images to help diagnose and treat diseases. The technique is also called *computerized tomography* or *computerized axial tomography* (CAT).

In a CT imaging procedure, a patient lies on a table that passes through a circular scanning machine called a *gantry.* The table is positioned so that the organ to be scanned lies in the center of the gantry. A tube on the gantry beams X rays through the patient's body and into special detectors that analyze the image produced. The gantry rotates around the patient to obtain many images from different angles. A computer then processes the information from the detectors to produce a cross-sectional image on a video screen. By moving the table in the gantry, doctors can obtain scans at different levels of the same organ. They can even combine scans to create a three-dimensional computer image of the entire body.

Sometimes an iodine solution, called a *contrast agent,* is injected into the body to make certain organs or disease processes show up clearly in the CT scan. For example, the patient drinks a barium mixture to outline the inner surfaces of the stomach and bowel.

Doctors use CT scans to diagnose many conditions, such as tumors, infections, blood clots, and broken bones. CT also may be used to guide a biopsy needle into diseased tissue. In addition, it assists in treating some diseases that might otherwise require surgery. For example, doctors can use a CT scan to guide *catheters* (small tubes) to an abscess in the body and drain pus from the infected area. P. Andrea Lum

See also **Radiology; X rays.**



WORLD BOOK photo by Robert Frerck

A CT scanner makes a cross-sectional view of body parts. A scanning machine, *background,* shoots X rays through the body from many angles. A computer forms an image on a screen.



©Getty Images

Computers make certain types of tasks easier for people in all walks of life. People use them in homes, schools, libraries, and workplaces. Some business operations, such as the trading floor of the Boston Stock Exchange, *shown here,* require hundreds, or even thousands, of computers.

Computer

Computer is a device that processes information with astonishing speed and accuracy. Computers process information by helping to create it and by displaying it, storing it, reorganizing it, calculating with it, and communicating it to other computers. Computers can process numbers, words, still pictures, moving pictures, and sounds. The most powerful computers can perform trillions of calculations per second.

The computer has changed the way we work, learn, communicate, and play. Virtually every kind of organization throughout the world uses computers to conduct business. Students, teachers, and research scientists use the computer as a learning tool. Millions of individuals and organizations communicate with one another over a vast network of computers called the Internet. Computer games entertain people of all ages.

Almost all computers are *electronic digital computers.* They are electronic in their use of *electric current* (a flow of electric charge) to carry information. They are digital in that they process information as distinct units of electric charge representing numbers. The word *digital* means *having to do with numbers.*

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To enable a computer to process information that is not numerical—such as words, pictures, or sounds—the computer or some other device must first *digitize* that information. A device digitizes information by translating it from its original form into electric charges that represent numbers. After the computer processes the digitized information by working with the numbers, the computer or a device connected to it translates the results back into their original form.

For example, an artist might use a machine called a *scanner* to digitize a photograph. He or she might then process the photograph on a computer to change it—perhaps to remove an unwanted element. The artist could then use a printer connected to the computer to produce a copy of the altered photo.

Digital computers are one of two general kinds of computers. The other kind are calculating devices called *analog computers.* An analog computer represents amounts with continuously varying physical quantities—such as voltages, flows of fluids, or distances along a scale—rather than with numbers. The remainder of this article deals with digital computers. For more information on analog computers, see **Analog computer.**

The technology of computer *hardware* (the physical parts of computer systems) has advanced tremendously since 1946, when the first electronic digital computer was built. That machine filled a large room. Today, a

fingernail-sized computing device called a *microprocessor* can do much more work than that pioneering machine in a shorter time.

The technology of *software* (computer programs, or sets of computer instructions and information) has also advanced rapidly. Early computer users wrote their own software, because little or no software was commercially available. Today, most users buy programs created by companies that specialize in writing software, though anyone with proper training can create their own programs. Hundreds of thousands of different programs are available for businesses and individuals.

Because of advances in hardware and software, the price of computing has dropped sharply. As a result, the number of computers in operation has risen rapidly ever since the first commercial digital computers were manufactured in the 1950's. Today, several hundred million computers are in operation worldwide.

Kinds of computers

Computers vary greatly in size, speed, and ability. They may be grouped into four categories: (1) personal computers, (2) mainframes and supercomputers, (3) dedicated computers, and (4) embedded computers.

Personal computers are used by one person at a time. The largest personal computers, or PC's, can fit on a desktop. Some of these machines have more than one microprocessor. In addition to one or more *primary processors,* a computer may have one or more *co-processors* to handle special types of work. For example, *math co-processors* help speed up complex numerical calculations. *Graphics co-processors* help process photographs and other illustrations, or they speed up operations involving the display of information. *Sound co-processors* perform the mathematical calculations to process digitized sound.

Large and middle-sized businesses commonly use PC's in *networks.* A network consists of a group of computers connected by telephone lines or other communications lines. In a *client-server network,* a powerful central computer distributes information to a number of PC's. The central computer is called the *server.* The PC's are the *clients* but are usually referred to as *workstations* or simply *PC's.* The central computer may be a PC, a machine like a PC with extra storage capacity, or an even larger type of computer.

The server also stores all the network's essential information. In a typical network, individuals operating the workstations obtain copies of information from the server. The workers process this information, then send copies of the processed information back to the server. In most cases, the employees work in the same office as the server. But a large company may have a network that connects its branch offices to the main office. In addition, some employees work on computers at home and send their processed data to the company server. This use of computers is known as *telecommuting.*

Office workers also use PC's that are not connected to a network. These machines are used for such tasks as word processing, performing financial calculations, and organizing and sorting bodies of information called *databases.* Home users of computers do some of the same kinds of work. They use word-processing programs for private correspondence, financial software for household budgets, and database management programs for address lists and recipes. Individuals also use their home computers to play games and to communicate over the Internet.

Individual computer users may connect several computers, as well as other appliances, into a *home network,* which may be either a client-server network or a *peer-to-peer network.* A peer-to-peer network has no central server, but computers connected to the network can share *files* (bodies of processed information), printers, and other resources.

Computer terms

Artificial intelligence is a branch of computer science that seeks to process information in a way similar to the way people think and reason.
Binary numeration system is a system of number symbols used by computers. The system uses only the numerical symbols 0 and 1.
Bit may be either the digit 0 or the digit 1. The term *bit* is an abbreviation of *binary digit.*
Byte is a combination of eight bits used to represent a single unit of information, such as a letter or numeral.
CD-ROM is a disc, much like an audio compact disc, that stores computer programs and other files. The term *CD-ROM* is an abbreviation of *C*ompact *D*isc *R*ead-*O*nly *M*emory.
Database is a large body of organized information that can be searched in several ways.
File is the smallest unit in which processed information is stored. There are *text files* and *sound files,* for example.
Floppy disk is a small disk enclosed in a hard plastic case that is used to store information.
Hard disk consists of one or more platters that store information. The hard disk is built into the computer.
Hardware refers to the physical parts of a computer system.
Internet is a worldwide computer network to which hundreds of millions of computers are linked.
Machine language is a collection of bits that represent operations and memory addresses.
Memory chip is a part of a computer that stores information for immediate use by a microprocessor.
Microprocessor is the part of the computer that does the actual computing. Some computers have more than one microprocessor.
Modem is a device that enables computers to communicate with one another over telephone lines.
Monitor is a device that produces a visual display of words and images.
Motherboard is the main circuit board of a computer. It includes the primary processor and a collection of memory chips.
Mouse is a device a user moves on a flat surface to give certain instructions to a computer.
Multimedia is a combination of text and such media as sounds, illustrations, and moving images.
Network is a system of two or more computers connected by communications lines.
Online service is a commercial computer network to which a subscriber pays a monthly or hourly fee.
Operating system is software that controls the operation of the entire computer system.
Program is a set of instructions to be carried out by a computer.
Scanner is a machine that uses light and devices that sense light to translate illustrations into numerical information.
Software consists of instructions that control the operation of the computer.
Virtual reality is a computer-created artificial environment through which a computer user can seem to move.
World Wide Web is a system of files linked to one another on the Internet. It enables the use of multimedia on the Internet.



A mainframe computer is housed in several large cabinets. Mainframes are the fastest electronic digital computers, and they use the largest information-storage systems. As a result, they can handle more complex problems than any other category of computer.

IBM Corporation

Small, battery-powered, portable PC's are popular with people who need to use a computer away from a desk. Such portables include *laptop computers,* which can be held on the lap; *notebook computers,* which are about the size of a loose-leaf notebook; and *handheld* or *palmtop computers,* which can be operated while held in the hand. Laptop and notebook computers are as powerful as desktop computers. Handheld computers are less powerful but still provide some advanced computing capabilities. People who deliver packages by truck use them for logging transactions or for obtaining signatures. Many people use handhelds called *personal digital assistants* (PDA's) to store addresses, keep daily calendars, send and receive *e-mail* (electronic mail) messages, and even use the Internet. Some wireless telephones can perform some of the same functions as handhelds do, including sending and receiving e-mail.

Many users of personal computers do not use the term *PC* to refer to all such machines. Instead, they apply the term only to machines using technology originally developed by International Business Machines Corporation (IBM). This usage comes from the name of IBM's first personal computer, the PC, introduced in 1981. The usage distinguishes IBM machines and *IBM clones* (machines made by other companies using IBM technology) from Macintosh personal computers, made by Apple Computer, Inc. Macintoshes are often referred to as *Macs.*

Mainframes and supercomputers are the most powerful computers. They are also the largest computers. Most of them are housed in several large cabinets. Mainframes use the largest storage systems. As a result, they can solve more complex problems and handle more information than can the computers of any other category. Some mainframes do a single job, such as copying and storing the information generated by a laboratory experiment. Others perform many different tasks.

Supercomputers are the fastest computers. These machines are used for major projects, such as the design of aircraft, the study of weather systems, and the design and analysis of drug molecules. Supercomputers are few in number because they are extremely expensive. Most supercomputer users are scientists and engineers at large scientific installations. The fastest supercomputers are *parallel computers.* They have dozens or even hundreds of processors that operate at the same time. Each processor works on a separate piece of a program.

Minicomputers and *superminis* have many of the capabilities of mainframes. However, they are smaller, less expensive, and less powerful.

Hundreds of people may be *logged on to* (running programs on) a large mainframe or a supermini at the same time. Such users are said to be *time-sharing.* During time-sharing, the computer seems to process information for all the users every instant. But it is actually switching rapidly from program to program, doing a small amount of work on one, then another.

Personal computers today have more processing power than the mainframes and supercomputers of the 1960's and 1970's. Many personal computers joined in a network can approach the capability of a modern mainframe at a fraction of the cost.

Dedicated computers are special-purpose machines. They include video game units and word processors. Video game units come in a range of sizes. The smallest are handheld, battery-operated toys. A larger unit for home use sits on the floor or a table and is connected to a television set. A player generally controls a home unit through a lever called a *joystick,* which may include a trigger and one or more buttons. The largest units stand on the floor in game rooms called *arcades* and in other commercial establishments.

Word processors were computers that resembled electronic typewriters. They were designed mainly for typing, editing, and printing letters and other documents. Since the 1980's, PC's with word-processing programs have almost entirely replaced dedicated word processors.

Embedded computers are control units built into the devices they control. Virtually all embedded computers are single microprocessors. Such devices as digi-

tal wristwatches, telephones, videotape recorders, and automobile ignition systems contain embedded computers. In addition, embedded computers help control the flight of aircraft, maintain the orbits of artificial satellites, and guide missiles to their targets. They also control the movements of industrial robots,

There are many more embedded computers than any other kind. For every personal computer, there are hundreds of embedded computers.

Computer code

All data used by a computer consist of electric charges that represent numbers. The computer uses only two levels of charge. One level represents the *digit* (numeral, or number symbol) 0, and the other level represents 1. Thus, the computer uses the *binary numeration system.* The word *binary* comes from a Latin word meaning *two at a time.* In the binary system, a 0 or a 1 by itself is called a *bit,* which is short for *binary digit.*

Number symbols in the binary system are much different from those in the *decimal system,* which we use in almost all other cases. For example, the symbol 10 in the binary system corresponds to 2 in the decimal system. For a discussion of the binary system, see Numeration systems.

In the computer, different combinations of bit charges represent numbers, letters, and portions of pictures and sounds—all the data that the computer processes and all the instructions used to process the data. The computer uses combinations of eight bits, called *bytes.* A byte may be one of 256 distinct *values,* or patterns of 0 and 1 bits. For example, in a common code known as the American Standard Code for Information Interchange (ASCII), the byte 01000001 represents the capital letter *A.* Other bytes in ASCII represent lower-case *a* and all the other letters, all the decimal digits, and certain punctuation marks and mathematical symbols.

In a computer, millions of tiny electronic switches called *transistors* process bit charges by switching them from circuit to circuit. Each switch operates much like an ordinary light switch. When a circuit is off, it corresponds to the binary digit 0. When a circuit is on, it corresponds to the digit 1. Binary digits, like decimal numbers, can be added, subtracted, multiplied, and divided. Thus, a computer can perform all the basic arithmetic operations.

Computer information is measured in multiples of bytes. A *kilobyte* equals 1,024 bytes; a *megabyte,* 1,048,576 bytes; a *gigabyte,* 1,073,741,824 bytes; and a *terabyte,* 1,099,511,627,776 bytes. For simplicity, 1 kilobyte, 1 megabyte, 1 gigabyte, and 1 terabyte are often said to equal 1,000, 1 million, 1 billion, and 1 trillion bytes respectively.

Parts of computers

A computer is made up of many *components* (parts). There are five main types of components: (1) microprocessors, (2) memory chips, (3) input devices, (4) storage devices, and (5) output devices. Microprocessors do the actual computing. Memory chips hold data and processing instructions for use by the microprocessors. The computer receives data through input devices, such as a keyboard. Storage devices, which include disks and tapes, hold data and instructions for transfer to and from



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A laptop computer is useful for people working away from a desk, such as these dockworkers. It provides the speed and the storage capacity of a desktop machine in a battery-powered unit.



© Donna Day, Corbis

A handheld computer has less power than a desktop machine. A model called a *personal digital assistant* (PDA), *shown here,* can store addresses, keep daily calendars, and do other tasks.

memory. Output devices, such as a televisionlike *monitor* or a printer, show results of the computer work. A single computer may have many input, output, and storage devices.

In desktop PC's, the primary processor, known as the *central processing unit* (CPU), is a powerful microprocessor chip. Components that control *peripheral* devices, such as the keyboard, mouse, monitor, printer, and disk drives, are on other chips.

Modern computers are designed so that a technician can change their capabilities by adding or removing components. In a typical PC, for example, many components are mounted on thin, rigid boards called *circuit boards.* A circuit board called the *motherboard* holds the CPU, peripheral chips, and a collection of memory chips. Other components, such as sound and graphics co-processors, come installed on circuit boards called *cards.* Cards can be plugged in to sockets called *expansion slots* inside the computer. Often, common components are integrated directly into the motherboard. Peripherals connect by wire or cable to sockets called *ports.*

Microprocessors control computer systems and process information encoded as units of electric charge. After completing an operation, a microprocessor may send the result to the computer's memory until it is needed for another operation. Or the result may be directed to an output device or a storage device.

A microprocessor consists of thousands, or even millions, of transistors, other electronic devices, and wires. These parts are arranged in circuits and built into a single chip, usually made of silicon, that is no larger than a fingernail.

A microprocessor has two groups of circuits: (1) the *control unit* and (2) the *digital logic unit,* also called the *arithmetic/logic unit.* Almost all microprocessor chips also contain a small amount of memory called *cache.*

The control unit directs and coordinates computer operations according to instructions stored in the computer's memory. Each set of instructions is expressed as a *binary operation code.* This code also indicates where data for each processing operation are stored in the memory. The control unit interprets the instructions and relays commands to the digital logic unit. The control unit also regulates the flow of data between the memory and the digital logic unit and routes processed information to output or storage devices.

The digital logic unit carries out the computer's mathematical and logical processes. In this unit, circuits called *registers* temporarily store data from the memory. To carry out a calculation, a group of charges travels from a register through a wire to the appropriate circuit. The result comes out on a wire at the other end of this circuit. The logic unit has a number of kinds of basic circuits. Various combinations of these circuits perform different mathematical and logical operations. For example, one combination of logic circuits performs addition. Another combination compares two numbers, then acts on the result of the comparison.

Memory chips hold data and instructions inside the computer. Like microprocessors, they consist of transistors, other electronic components, and wires arranged as circuits built into chips no larger than a fingernail.

There are two basic kinds of memory chips: (1) *read-only memory* (ROM) and (2) *random-access memory* (RAM). A ROM chip holds its memory even when the computer is turned off. However, the computer user cannot change the memory. ROM chips hold instructions that a computer must follow when it is first turned on or frequently used system services. A RAM chip holds its memory as long as the computer is turned on, but the user can change the memory. Random-access memory is sometimes called *internal memory* or *main memory.* RAM chips receive information and instructions from a microprocessor, an input device, or a storage device. They store only the information that is currently needed by a microprocessor.

Input devices send information and instructions to the computer. Some input devices are hand-operated, but others work automatically once they are turned on. There are nine main kinds of hand-operated units: (1) a keyboard, (2) a mouse, (3) a trackball, (4) a pointing stick, (5) a touchpad, (6) a digitizing tablet, (7) a touch screen, (8) a light pen, and (9) a joystick. There are three principal types of automatic units: (1) a modem or a network interface card, (2) a scanner, and (3) a microphone. In addition, all storage devices can function as input devices.

A keyboard is the main input device of most computers. Modern computer keyboards have letter and numeral keys, and several other character keys, organized in the same way as typewriter keyboards. However, they also have a number of keys that typewriter keyboards do not have. Along the top of the keyboard of a desktop PC, or sometimes along the left side, is a set of *function keys,* which are designated *F1, F2, F3,* and so on. Function keys perform special tasks, depending on the program that is running. Such a task might, for example, include removing a word or a passage of text from one part of a document and replacing it with another.

Elsewhere on the keyboard, in one or more sections called *keypads,* are keys that control the movement of an electronic marker that appears on the monitor screen. This marker, called a *cursor* or *insertion point,* designates where operations occur. For example, the cursor may indicate where the next character typed will appear. Special keys with such names as *alt, command, control,* and *option* give other keys extra functions. Not all keyboards have the same special keys. Keyboards for Macs have control, command, and option keys, while keyboards for PC's have control and alt keys. Many types of Mac software enable a Mac user to prepare the computer to print a document by pressing the command and p keys at the same time. On a PC, the user often performs the same task using the control and p keys. Some keyboards can be reprogrammed to change the function of certain keys.

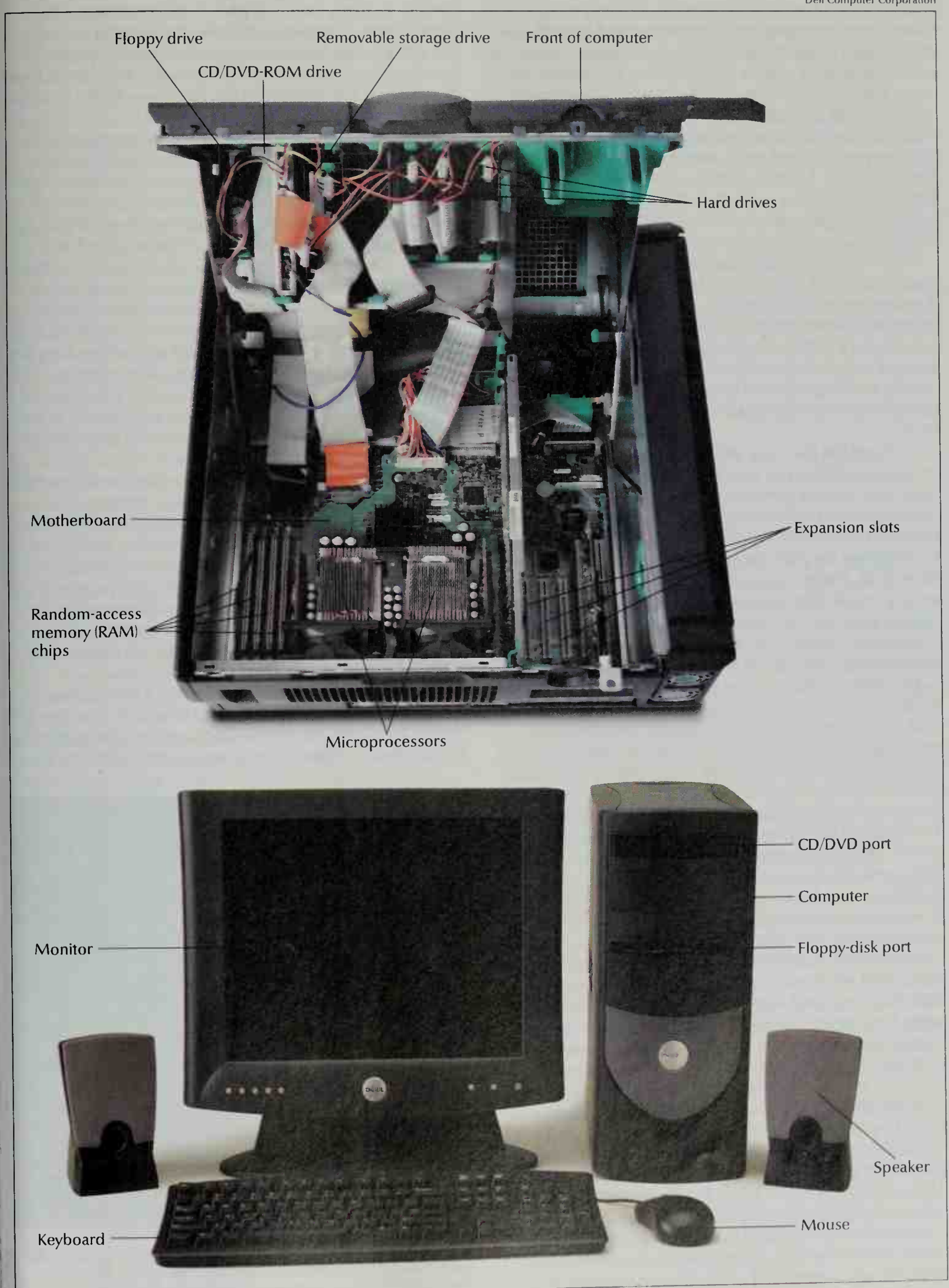
A *cordless keyboard* uses infrared or radio waves rather than a cable to send information to the computer. It thus reduces the clutter of cables on the desktop and enables a user to work at a greater distance from the screen than a cable will allow.

Some computing systems are text-based—that is, they rely only on typed commands from a keyboard. Such a system is called a *command line interface* (CLI).

A mouse is a palm-sized device that the computer user moves about on a flat surface. The mouse has two functions: (1) to move the insertion point and (2) to give commands to the computer. Computer users commonly

Parts of a computer The components inside a desktop computer's housing, *top,* include one or more microprocessors, memory chips, and disk drives. The input and output devices commonly sold along with a desktop computer are a keyboard and a mouse, and a monitor and speakers, *bottom.*

Dell Computer Corporation



operate the mouse on a smooth sheet of plastic or rubber called a *mouse pad.* Built into the bottom of a standard mouse is a ball that rotates when the user moves the mouse. When the mouse moves on the pad, an electronic code representing the movement of the ball travels by cable to the computer box. A microprocessor uses this code to move a cursor called a *pointer* in the same way as the mouse moved. An *optical mouse* does not use a ball but instead uses small light sources and detectors to determine the movement of the mouse. A *cordless mouse* uses radio waves to communicate with the computer. A mouse can be connected to most laptop or notebook computers, though these devices come with other, more compact devices that accomplish the same tasks.

On the upper surface of a mouse are one, two, or more buttons. A mouse for a Mac has one button, while a mouse for a PC typically has two. Each button may represent a different action to the computer. A mouse with two or more buttons is generally designed for right-handed use. However, the mouse's control software usually enables a user to reverse the actions of the buttons so that the mouse can be used easily with the left hand.

To move the insertion point, the user moves the mouse to position the pointer in the new location. The user then presses a mouse button and releases it, an action known as *clicking the mouse.* To give a command, the user moves the mouse so that the pointer travels to an image on the monitor screen that represents that command. These images may resemble push buttons, or they may be tiny pictures called *icons.* The user then clicks the mouse. Some commands require that the user *double-click* the mouse—that is, click the mouse twice in rapid succession without moving it.

The user can also use the mouse to *drag* (change the location of) an icon or other object on the screen. The user moves the pointer to the object, then presses a mouse button. Holding the button down, the user moves the mouse. The pointer and object move together to the new location. The user then releases the button, removing the object from the control of the mouse. This action is called a *click-drag.* Other uses of the mouse include dragging *windows* (rectangular frames that appear on the screen) and changing their sizes, and selecting items from *menus* (lists of actions). The system of windows, icons, menus, pointer, and mouse is known as a *graphical user interface* (GUI).

A trackball is commonly used instead of a mouse on laptop and notebook computers. The main part of this device is a ball built into the keyboard. The ball has the same function as the ball built into the bottom of a mouse. Turning the ball by hand moves the pointer. Buttons next to the trackball take the place of the buttons on a mouse. Trackballs are also sold as peripherals.

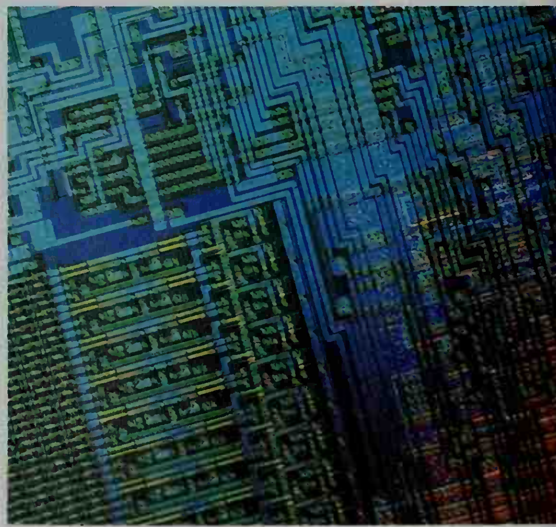
A pointing stick is a tiny rubber button positioned between two keys in the keyboard of a laptop or notebook computer. Moving the button left, right, up, or down, moves the pointer in the same direction on the screen. The pointing stick is so small that it does not interfere with a user's typing on the keyboard.

A touchpad, also called a *track pad,* is a rectangular, touch-sensitive area in front of the keyboard on a laptop or notebook computer. Touchpads are also sold as peripherals for desktop computers. A touchpad accomplishes the same tasks as a mouse. Sweeping a finger on the surface of the touch pad moves the pointer on the screen. Tapping the touchpad's surface performs the same action as clicking a mouse, and tapping twice is the same as double-clicking. A tap followed quickly by a sweep is the same as a click-drag. Some touchpads have buttons that can be clicked the same way as the buttons on a mouse.

A digitizing tablet may be used to perform the same functions as a mouse. Or, with the proper software, it can enable a computer user to write words or draw pictures directly into the computer. A *stylus,* or pen, that looks like a ballpoint pen contains electronics that interact with the surface of the tablet. When the user moves the stylus on the tablet, electronics in the tablet continually send information on the stylus's position to the computer. The computer uses this information to draw images on the monitor corresponding to the motions of the stylus. A tablet may be designed so that touching the stylus to certain positions sends special commands to the computer. A tablet may be as small as a mouse pad or as large as a drafting table. A user may place a drawing, map, or other document on the tablet and trace it into the computer.

Some digitizing tablets are used with a *puck* instead of a stylus. A puck resembles a mouse without a ball. But, like a stylus, it contains electronics that work with those in the tablet to determine its position with great precision. A puck usually has four or more buttons. Some people use a puck and tablet to design products on a computer in a process called *computer-aided design* (CAD) or to work with databases known as *geographical information systems* (GIS), which contain information on land features.

A touch screen can be described as a transparent tablet covering a computer's display screen. Pressing the screen sends the corresponding position information to the computer. Some screens work with the touch of a



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An integrated circuit contains all of the tiny devices that make up the processor on a single, tiny chip. This photo, taken through a microscope, shows a portion of such a chip.

finger. Others work with a penlike tool that, like the tool used with a digitizing tablet, is called a *stylus,* but which contains no electronics. Such computers are called *pen-based computers.*

Palmtop computers and other portable pen-based computers typically have a touch screen instead of a keyboard. Users select menu options, press images of buttons, and draw on the screen with the stylus. Users can also write characters and words. The computer processes the words as pictures, rather than as individually encoded letters. However, a computer equipped with *handwriting-recognition software* can translate hand-printed characters into encoded letters. Some palmtop computers display a picture of a keyboard on the screen. Users may enter encoded characters by tapping the picture of the keyboard with the stylus.

A light pen is an electronic wand with a light-sensitive tip. The user touches the light pen to the monitor screen to make selections or to "draw" on the screen. Other input devices, such as the mouse, digitizing tablet, and touch screen, have largely replaced the light pen.

A joystick is a lever held in the hand that conveys direction instead of a position. A joystick may be tilted forward, backward, left, or right. Some joysticks may also be twisted left or right. Often there is a trigger button on the front of the stick to be clicked with the index finger, and one or more buttons on the top that can be pressed with the thumb. Joysticks are often used to operate computer games, instructing the computer to move an object or character in a particular direction on the screen. For example, tilting the joystick to the left might cause a computer-generated airplane to fly to the left, and pulling the trigger might activate a simulated weapon.

A modem or a network interface card links a computer to a network and enables it to communicate with other computers linked to the same network. Each of these two types of devices function as both an input and an output device. A modem converts computer data to tones that can be sent and received over standard telephone lines. It also converts tones it receives over telephone lines back to computer data. This device transmits data much faster than an ordinary modem. A network interface card, also called an NIC, enables a computer to link directly to other computers within its own network; to a high-speed communications connection, such as a DSL (digital subscriber line) or an ISDN (integrated services digital network) line; or to a special type of modem known as a *cable modem.* A cable modem is used to link a computer to a network over cable television lines. NIC's and cable modems transmit data much faster than telephone modems.

An NIC is an *internal* device—that is, one inside the computer housing. A modem may be either an internal device or a peripheral. Many computers are sold with a modem already installed. See Modem.

A scanner is a peripheral unit that uses light and devices that sense light to digitize photographs and other illustrations. Publishers are major users of scanners, but scanners are also popular with home computer users. A scanner equipped with *optical character recognition* (OCR) software can translate the scanned image of text into individually encoded characters.

There are three main types of scanners: (1) flatbed scanners, (2) sheet-fed scanners, and (3) hand scanners. *Flatbed scanners* are the most widely used. A flatbed scanner has a glass surface at least as large as a standard sheet of paper. The user lays the material to be scanned face down on the glass. Devices scan the image through the glass and digitize it. A *sheet-fed scanner* scans one printed item at a time by rolling it past its imaging electronics. A user holds a *hand scanner* in one hand and rolls it over the material to be scanned. Most hand scanners are narrow, and so they must be passed over a page section by section. The scanner's software must then "stitch together" the individual scans into a single image.

Laser devices that read bar codes at checkout counters in stores are also types of scanners, but they do not digitize images. They instead send coded numerical information to a store's main computer.

A microphone translates sound into electric current, which a *sound card* in the computer then digitizes. The user can process the sound information by itself or as part of a different kind of file—for example, a motion-picture file. Digitized sound information may be sent over a network from one computer to another. It can then be converted back into sound by the sound card of the receiving computer.

A microphone is also used in *voice recognition,* the use of a microphone and digitizer to help a computer recognize spoken words. Voice recognition can enable a computer user to give computer commands by speaking them or to dictate to a word-processing program.

Storage devices save computer files on storage *media,* objects that can hold digital data. All programs and data are stored in files—each accessible to the computer by its file name. There are different types of files for different types of information. For example, a user might store a business letter as a *text file* and a photograph as a *graphics file.* A photograph takes much more storage space than text does. For example, a single high-quality photo may take up as much as 40 megabytes of space, roughly the space required by 20,000 pages of double-spaced typewritten text. The smaller the image, the less storage space is required.

Storage devices include hard drives, floppy drives, CD drives, DVD drives, and tape drives. All these devices can also serve as input and output devices.

Hard drives contain one or more *hard disks*—magnetic disks that hold data—in a sealed enclosure. Each disk consists of several plates called *platters,* which are stacked on top of one another. Data are stored on *tracks* (circular bands) on each side of a platter's surface. An individual hard disk has thousands of tracks. Each side of a platter has a device called a *read/write head* that moves in and out to specific tracks to store or to call up data for the computer to use. Hard drives also have cables and other hardware for transferring data to and from the computer.

CD-ROM drives read data from CD-ROM's, the most common means of distributing software to PC's. The abbreviation stands for *C*ompact *D*isc *R*ead-*O*nly *M*emory. The phrase *read-only memory* means that CD-ROM's are permanently inscribed with their data. The computer cannot insert, change, or delete any of the data.

A standard CD-ROM can store about 650 megabytes, roughly equivalent to 250,000 pages of double-spaced typewritten text. CD-ROM's are a popular means for dis-

tributing multimedia programs. Such programs combine several forms of information—text, illustration, animation, and sound, for example. See **Compact disc.**

DVD-ROM drives read DVD's, discs that are the same size as CD-ROM's but hold much more information. A DVD stores data on one or both sides. Capacities range up to a total of 17 gigabytes for storage on both sides. DVD-ROM drives can also read CD-ROM's. See **DVD.**

Floppy drives store data on *floppy disks*—small, flexible magnetic disks encased in hard plastic shells that can be inserted into and removed from the drive. Floppy disks are used to store information for later use by the same computer, and to move information from one computer to another. Typical floppy disks can store from 1 to 2 megabytes of data.

Removable storage drives store data on high-capacity disks or cards. Computer operators use them to expand storage capacity beyond what is available on the hard drive, to store data for transport between computers, and to *back up* (make copies of) large amounts of information stored on hard disks. If the hard disks were to fail or become damaged, an operator could restore the information by copying it from the removable disks or cards.

Some removable storage drives are essentially hard drives without permanently mounted disks. Disks encased in special cartridges can be inserted into and removed from these drives. Such disks can store up to 20 gigabytes of data.

Other types of devices that store data on removable discs include *CD-R* and *CD-RW drives.* These drives record data on two special kinds of compact discs. A *CD-R* (*C*ompact *D*isc-*R*ecordable) can be recorded only once, and the data on it cannot then be changed or erased. A *CD-RW* (*C*ompact *D*isc-*R*e*W*ritable) can be recorded over and over again, and data can be erased or changed. CD-R and CD-RW drives can read virtually all other types of CD's. Most ordinary CD-ROM drives can read a CD-R. Modern, highly sensitive CD-ROM drives can read CD-RW's. Like CD-ROM's, CD-R's and CD-RW's can store up to 650 megabytes of data. A smaller type of CD-R, about two-thirds the diameter of a regular CD-R, can store up to 185 megabytes of data. Some digital cameras record images on these discs.

Some removable storage devices use memory cards that store data using memory chips. Most cards store up to 1 gigabyte of data.

Tape drives store data sequentially on magnetic tape in much the same way as audiotape recorders store sound information. They copy data much more slowly than do disk drives. The main use of tape drives is to back up information stored on hard disks.

Output devices display the work done by the computer. These devices include monitors, printers, plotters, and speakers.

Monitors have a screen much like a television screen. Modern monitors offer millions of color combinations. The most common type of monitor used with a desktop machine is a *cathode-ray tube* (CRT), a vacuum tube like a television picture tube.

Laptop and notebook computers use *flat panel screens* that are not CRT's. Most use *liquid crystals*—molecules that change how much light they reflect or transmit when activated by electric signals. Some desktop machines also use flat panel screens.

Certain embedded computers, such as those in early electronic calculators and some automobile displays, use single-color *light-emitting diodes* (LED's), solid crystals that emit a brightly colored light in response to electric energy. For many uses, LED's have been largely replaced by liquid crystal displays, which consume less electric power.

The smallest screens are only about a half-inch (13 millimeters) diagonally. Headsets or goggles used for viewing *virtual reality* programs use two such screens, one for each eye. The eye perceives the images as full-size. Virtual reality programs use graphics and other tools to create an artificial world through which the user seems to move.

Printers produce output on paper. There are three major types: (1) laser, (2) inkjet, and (3) dot matrix.

Laser printers operate by electrically charging a special cylinder in patterns that represent a computer document, including text and illustrations. Dry ink called *toner* is given an electric charge opposite to the charge of the patterns on the cylinder. Toner is dusted onto the cylinder, and the opposite electric charges attract, causing toner to stick only where text and illustrations should appear. A sheet of paper is given an electric charge that will attract the toner and that is stronger than the cylinder's charge. When the paper presses against the cylinder, the toner transfers to the paper and then is heated for an instant. The toner melts, then resolidifies, creating a copy of the document on the paper. This process is similar to that used by a photocopier. In some color laser printers, the paper passes over the cylinder four times, with either black, yellow, *magenta* (purplish-red), or *cyan* (bluish-green) toner being used in each pass. Others pass the paper over four cylinders—one for each of the four toner colors.

Inkjet printers spray ink onto paper using a tiny nozzle that quickly moves back and forth to form text and illustrations. Color inkjet printers have separate ink tanks for each primary color and for the color black.

Dot-matrix printers use tiny pins that strike an inked ribbon positioned in front of the paper. Laser and inkjet printers have largely replaced dot-matrix printers. But dot-matrix printers are still used in situations that require impact, such as printing on multiple-sheet forms.

Plotters use pens to create drawings, diagrams, and graphs on paper or clear plastic. Architects often use plotters to prepare large blueprints and plans.

Speakers play sound files. Most laptop computers come equipped with tiny, built-in speakers. Desktop computers usually come with separate speakers that can produce high-quality sound. These speakers must be connected to the output *jack* (device that can receive a plug) of the computer's sound card. Separate speakers may also be used with a laptop computer.

Computer software

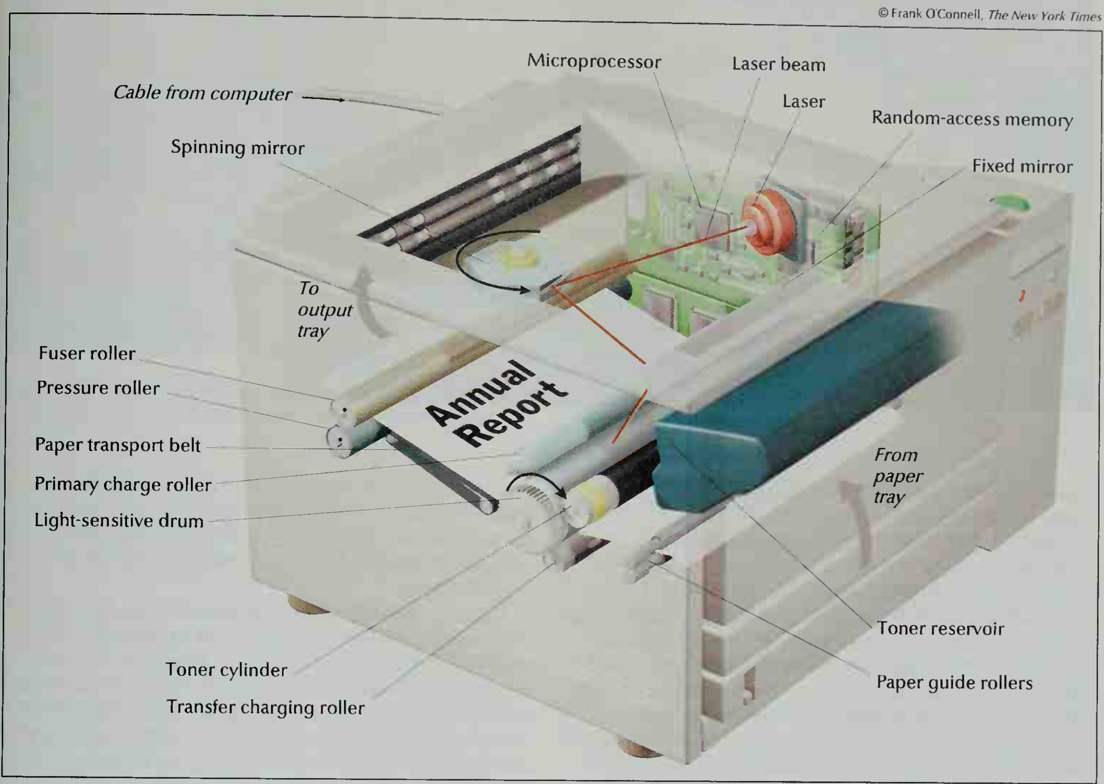
Computer software consists of instructions that control the operation of the computer. Much software also includes information for the computer to process. There are two main kinds of software: (1) operating system software and (2) applications software.

Operating system software reads and responds to user commands, and coordinates the flow of informa-

Parts of a laser printer

Inside a laser printer, a tiny laser electrically charges parts of a light-sensitive drum, duplicating on its surface the text and images of a computer document. *Toner* (dry ink) is dusted onto the drum and sticks to the charged areas. When rollers heat the paper, the toner transfers to it.

© Frank O'Connell, *The New York Times*



tion among the different input and output devices. It also manages the programs the user runs. It puts these programs and the user's data into memory and makes sure that the processor executes the correct commands. Because operating systems serve as the *interface* (go-between) for computer users and their programs, much work has gone into operating system design.

Such operating systems as MS-DOS (*M*icro*s*oft *D*isk-*O*perating *S*ystem) and Unix are *command line interfaces* (CLI's). CLI's use typed commands that users must memorize or look up. Systems that use icons in place of typed commands are called *graphical user interfaces* (GUI's).

Applications software is made up of programs for all the specific uses of computers. Such uses include word processing, the management of financial and other numerical documents, database management, and the processing of pictures and sounds.

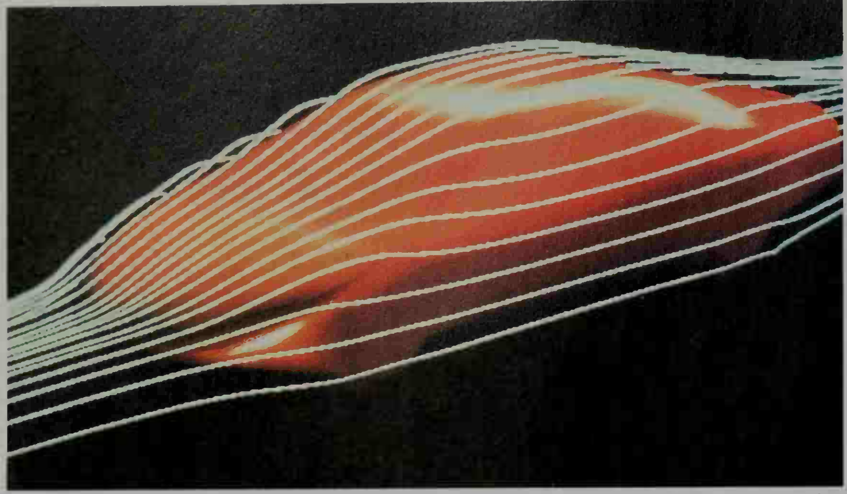
Word-processing programs enable people to type words into a computer to write articles, books, reports, letters, and other documents. Word-processing software greatly simplifies the work of editing a document. The user can insert, change, move, or delete letters, words, or groups of words, or even entire sections of a document. The software automatically adjusts the remainder of the document to reflect the changes.

The user can change the appearance of characters by making them boldface or italic, or by changing the typeface. The user can also change the appearance of paragraphs by setting the line spacing, indentation, or *justification* (alignment) of lines. He or she may apply changes to all pages of an article, such as adjusting margins, adding page numbers, or adding information at the top or bottom of every page as *headers* and *footers*.

Word-processing software usually includes dictionary and spelling programs that can check a document, pointing out possible errors and offering corrections. Some software can also check grammar and punctuation. When a document is completed, the user can print it or distribute it over the Internet or by floppy disk, removable storage cartridge or card, or CD.

Spreadsheet programs are the leading type of financial software, but they may also be used for any general mathematical problem. The word *spreadsheet* refers to a table used to present information in these programs. The table's basic structure is a series of vertical columns and horizontal lines. The rectangles created by the intersection of the columns and lines are called *cells*. Each cell represents a specific piece of information, such as the cost of a product or the number of units sold. The user enters numbers, text, and mathematical equations into cells. A spreadsheet may contain millions of cells.

Mathematical equations link cells so that a change in one cell automatically changes all related cells. For example, if a student entered the amount $10 in a cell representing dues paid to a school club, the equation in the



Computers enable engineers to predict how a machine will work. This photo shows a computer image of a car being tested for wind resistance.

© Hank Morgan, Photo Researchers

cell representing the club's total income would automatically increase its value by $10.

A technique called *spreadsheet modeling* is a major tool of business. A corporate accountant, for example, might create a *model* (mathematical description) of the corporation's financial position to examine various *what-if scenarios*. The accountant might do this by changing the numbers in certain cells several times to represent each of several decisions that the corporation is considering—for example, building a new warehouse in either of two regions or expanding an existing one. With each change the accountant makes in a cell, the computer would automatically change the related cells. The accountant could then examine the results of each of the potential decisions.

The first spreadsheet program was *VisiCalc,* introduced in the late 1970's for the Apple II personal computer. Many computer experts consider *VisiCalc* to be the single program that persuaded many business people to use PC's. The program could perform only simple calculations over a limited number of cells. Today's spreadsheets for PC's offer hundreds of functions. In addition, spreadsheets representing different aspects of a mathematical problem can be linked together. A change in a cell of one spreadsheet is reflected in related cells in all linked spreadsheets.

Most programs incorporate graphics tools that can convert spreadsheet data into charts, graphs, and other illustrations. Some software provides *presentation tools,* computer instructions for generating posters or photographic slides.

Database management programs enable users to store large bodies of information in databases and to then search the databases in several ways. A user can combine different databases based on information that they have in common. The efficiency with which computers store and retrieve information makes database management a major function in a wide variety of professions. Scientists store the results of experiments and compare their results with those of other scientists. Libraries use computerized catalogs to hold information about their collections. Hospitals maintain databases of patient records. Governments store election returns, tax records, and census information in databases. Businesses keep databases of information about their employees, customers, and products.

Graphics programs enable computer users to create, change, and display pictures. The term *computer graphics* refers to pictures produced using these programs. A user can create an original image on the computer or can use a photograph or other previously created picture that has been digitized. The user can change an im-









John O. Hallquist © Discover Publications

A computer simulation can accurately represent an operation, situation, or system. The first three photos show computer-generated images of a bomb's nose cone striking a steel plate. The fourth photo—which shows an actual nose cone after a test—reveals the great accuracy of the computer simulation.



© Brownie Harris, Corbis Stock Market

Computers help meteorologists forecast the weather by solving equations that describe the behavior of the atmosphere.



© Arthur Tilley, Getty Images

Video game units, such as arcade machines, are *dedicated computers,* devices designed mainly to perform one task.

age in a variety of ways. He or she can alter its dimensions or its colors. Or the user can move, copy, or eliminate a portion of the image. Elements of many images can be combined into one. A finished picture can be displayed, printed, sent to other computers via the Internet, or saved on a disk or other storage medium.

Some computer graphics software works with motion pictures. Moviemakers create many spectacular special effects with computer graphics. In 1995, *Toy Story* became the first feature-length motion picture created entirely on computers.

Graphics programs called *presentation software* enable users to create charts, graphs, and posters for business or educational presentations. Special hardware enables a user to project the graphics onto a motion-picture screen from the computer itself. Most presentation software can produce special effects, such as images that fade away or transform into other images, and even sound effects. Graphics created with presentation software may be transferred to photographic slides.

Publishing programs enable publishers to prepare books, magazines, and newspapers for printing. Writers, editors, and production specialists prepare the text on computers. Also using computers, designers lay out the pages, selecting typefaces, column arrangements, and placement of illustrations. Artists and illustrators use computers to create and manage the graphics. Several publishers create publications that are not actually printed but are instead displayed only on computers. Many home computer users also use publishing software. Individuals use these programs to produce newsletters, greeting cards, and other documents on their PC's.

Games software combines graphics, animation, sound, and music with clever design to produce exciting adventures and puzzles. Computer games are played on PC's or video game units. With a keyboard, joystick, or other input device, a player controls the movement of one or more characters or other elements. Two or more players can play some computer games by using computers linked to a network.

Virtual reality (VR) software uses graphics, sound, and other tools to create an artificial world through which a user can seem to move. Virtual reality systems generally include a headset that has two tiny display screens, one for each eye. The images on the screens create the illusion of three dimensions when viewed together. When the user's head moves, the computer adjusts the images to the new perspective resulting from the movement.

Many virtual reality programs work with special hardware, such as sensor-lined gloves that the user wears. Such gloves provide the user with the illusion that he or she can touch and move objects in the virtual world. See **Virtual reality.**

Computer-aided design (CAD) programs are essential to many professions, especially engineering, manufacturing design, and architecture. An architect, for example, can create pictures that show every aspect of a building's wiring, plumbing, and construction components. Many products, even those as complex as automobiles and aircraft, have been planned with the aid of a CAD technique called *paperless design.* Powerful graphics and mathematics software enable designers to *simulate* (imitate) every part, ensuring that all the parts will fit together perfectly. Computer programs also test designs of machines by simulating various operating conditions. For example, aircraft designers run tests that simulate flight capabilities under all conditions a pilot is likely to encounter. Only after thorough testing is a designed object put into production.

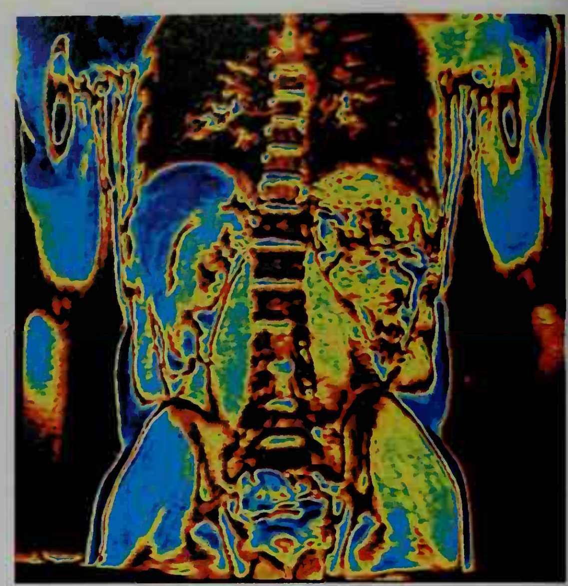
Scientific visualization software is used in virtually every branch of science. One use of this software is to develop and test theories. Astronomers, for example, use mathematical models to develop theories of how groups of stars form galaxies. First, an astronomer enters a model of a group of imaginary stars into a computer. The computer then either solves the equations or shows that the model is incorrect. A successful model will predict the shape of the galaxy that the stars would form. To test the theory, the astronomer can observe a real galaxy to see whether it has the predicted shape.

Scientists working in other fields use similar techniques. Biochemists, for example, model drug molecules. Meteorologists create models of weather systems to study how storms develop.



© Fritz Hoffmann, The Image Works

A computer-aided design (CAD) program helps a designer develop a part for an automobile. CAD techniques enable designers to ensure a proper fit between all the parts of a product.



© Scott Camazine/SPL from Photo Researchers

Computer graphics help produce pictures for medical diagnosis, such as this cross section, in a technique called *magnetic resonance imaging* (MRI).

Medical visualization software enables physicians and computer specialists to generate detailed images of a patient's internal organs, including the brain, without performing surgery. This software is used with such techniques as computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound imaging. The pictures help the physician make diagnoses and detect problems. Doctors can also send images over a computer network to other doctors in distant locations, making consultations with specialists easier and less expensive.

Artificial intelligence (AI) software enables a computer to imitate the way a person solves complex problems. For example, a physician investigating an illness does not solve the problem by performing mathematical calculations. The physician instead applies his or her education, training, and experience to the problem.

One type of AI software, called an *expert system,* enables a computer to ask questions and respond to information the answers provide. For example, a physician might use an expert system to evaluate a patient's symptoms. The computer would compare the combination of symptoms described by the patient with all the descriptions in its database, then suggest diagnoses and treatments. The computer does so by drawing upon rules and vast amounts of data that human experts have supplied to the writers of the software. The computer can narrow the field of inquiry until a potential solution is reached. However, if the rules and data available to the system are incomplete, the computer may not yield the best possible solution.

Educational software helps students learn. Different types of educational software may display lessons, ask questions, or provide reference resources. Some programs create simulations of such experiences as dissecting a frog or flying an airplane. Educational software appeals to students because it is *interactive*—that is, a student's response determines what happens next. The displayed information may take the form of text, or it may include sound and graphics as well.

There is educational software for every level of instruction, from elementary school through university and professional study. Educational software is especially useful for instruction in such subjects as mathematics or foreign languages, in which drill and practice reinforce the lesson. Educational software is also used for occupational training.

Software suites are popular software packages that combine several types of software. A suite may contain word processing, spreadsheet, database, and graphics or presentation software; communications software for use with a modem; and an electronic calendar and address book. The programs in a suite work together, enabling the user to transfer information from, for example, a spreadsheet to a word-processing document, merely by pressing a few keys.

Computer networks

The communication of data over networks is one of the most important and influential uses of computers. Using modems or network adapters, people can use computers to send text and graphics files, exchange messages, and search databases over the Internet. Businesses establish small networks for their own use. A *local area network* (LAN) connects a company's workstations within the same building or among neighboring buildings. A *wide area network* (WAN) links workstations over larger areas. Both LAN's and WAN's enable co-workers to exchange information rapidly. They also enable computers to share printers and storage devices.

The Internet, or *Net* for short, began in the late 1960's as *ARPAnet,* a group of interconnected military and other government computers in the United States. The U.S. Department of Defense created ARPAnet to keep these computers secure in the event of war or nat-

ural disaster. Soon after ARPAnet began, universities and other institutions created their own networks. These networks eventually merged with ARPAnet to form the Internet. The term *Internet* thus refers to a network of networks.

During the 1970's and 1980's, large numbers of businesses linked their computers to the Internet. The explosive growth of PC sales beginning in the late 1980's enabled many individuals to gain access to the Internet. Today, the Internet provides databases containing information on virtually every branch of human knowledge and enterprise—from the most serious scientific topics to catalogs of jokes.

Not all the information on the Internet is organized in formal databases. Computerized *newsgroups* let people post their own messages, bringing a flood of opinion, commentary, and debate to a host of topics. Computer games are also popular on the Internet. *Chat rooms* enable groups of people to have a conversation by typing messages to one another. A user of one computer may utilize the Internet to log on to and issue commands to a remote computer. The distribution of software is another important function of the Internet. Programs can be *downloaded* (received) over the Internet, then run on the computers that receive them.

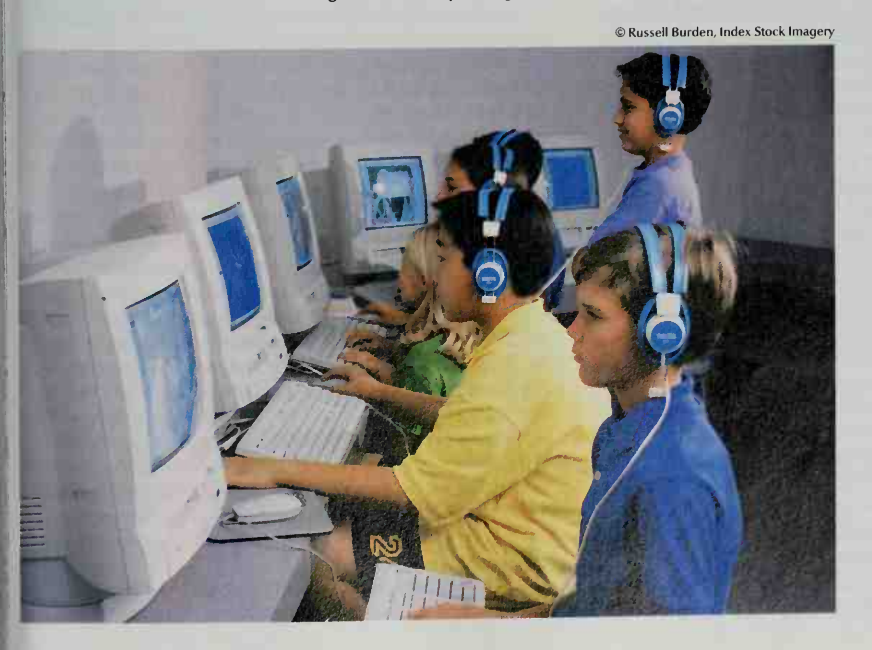
The World Wide Web, or *Web* for short, is a worldwide system of interconnected computer files linked to each other on the Internet. It was originally devised as a means for linking words in text files to those in others using linkages known as *hypertext.* Today, the Web consists of billions of documents, databases, images, sound and video files, newsgroups, and electronic publications. Much of the information has been converted from print into digital form, but even more has been created specifically for the Web. The material resides at *Web sites.* Each Web site on the Internet is identified by a unique address that has been registered through a registering agency. A Web site's address is called its *uniform resource locator* (URL). Using a software package called a *Web browser,* a computer user can select a URL and gain access to the Web site attached to that address.

A presentation language called HTML (hypertext markup language) is used to create files known as *Web pages* for the World Wide Web. Most Web sites consist of more than one Web page, and many consist of thousands of pages. HTML uses commands called *tags* to tell the browser how to display elements on a page. URL's may be embedded into a Web page to provide *hyperlinks* (hypertext links) to other pages. When a user clicks on a hypertext link, the browser takes the user to the linked page.

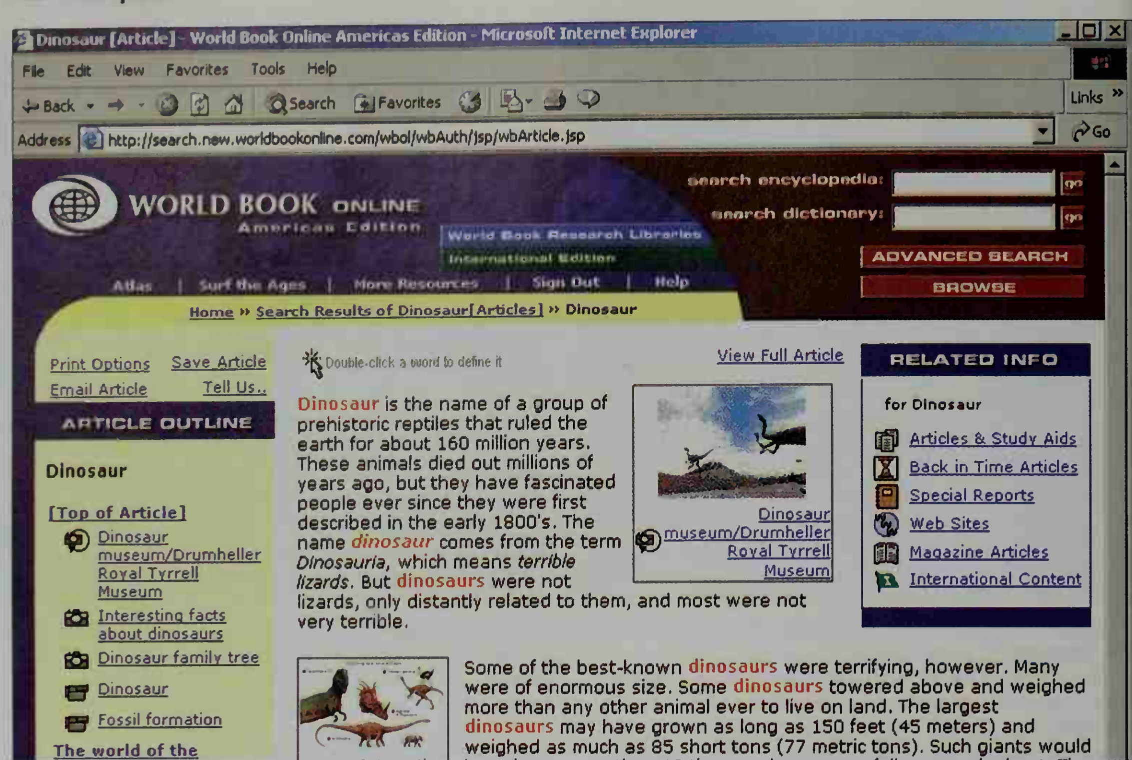
A visit to some Web sites will store a small amount of information on the user's computer in the form of a *cookie.* Information in a cookie includes the Web site's address and a record of what the user did at the site. Web sites use cookies to track a user's preferences. An online bookstore, for example, may use a cookie to recall that a visiting user searched for science-fiction titles during an earlier visit. The site may then automatically suggest new titles to the user.

Internet service providers (ISP's) and online services are commercial operations that connect a user's computer to the Internet. ISP's, such as Earthlink in the United States and Teleglobe in Europe, provide only a basic connection to the Internet. Users must select their own Web browsers and other Internet software. Online services provide the same primary service that ISP's do. They generally supply a browser, but a user may choose a different one. Online services also provide their own content, such as news, bulletin boards, databases, games, and software libraries. The largest online services, such as America Online (AOL) in the United States, Freeserve in the United Kingdom, and Telstra in Australia, have millions of subscribers.

A user establishes a connection to the ISP or online service through a modem or through another communication device connected to an NIC. Users pay a monthly or hourly fee to use an ISP or online service. Many gov-



Schools use computers as a teaching aid. In a computer laboratory, several students may run different educational computer programs. Or all of the students may work with the same program, each at his or her own pace.



WORLD BOOK photo

A Web page is a file represented by a specific electronic address on the Internet. A presentation language called HTML (hypertext markup language) is used to create such files. A piece of software called a Web browser displays the elements of pages according to HTML commands called *tags.*

ernment offices, businesses, libraries, and universities provide employees or students with access to the Internet.

Most ISP's and online services provide addresses that identify users so that they may send and receive e-mail. Most communications software includes a text-editing program in which a user can compose an e-mail message. The user can also attach one or more computer files to a message. The user can send the same message to several e-mail addresses at once. The computer automatically enters the sender's electronic address to tell the recipient who sent the e-mail. An electronic "mailbox" at each e-mail address stores the mail.

Some Web sites provide free e-mail services. A user must register with such a site to obtain an e-mail address. The user may register for more than one address. He or she can then send or receive e-mail after using any Web browser to connect to the proper Web site. Many e-mail services provide *filters,* which enable a user to screen out unwanted e-mail.

Internet software. A user may run any number of software packages that access the Internet over the same connection at the same time. These software packages include Web browsers, *terminal emulation programs,* and *FTP programs.* All of these programs use established formats called *protocols.* Web browsers use *hypertext transfer protocol* (HTTP), also called *hypertext transport protocol,* to retrieve Web pages. A terminal emulation program, such as Telnet, enables a user to utilize his or her own computer to log on to a remote computer. The user can then issue commands to the remote computer as though it was his or her own, even if the two computers use different operating systems. FTP, or *file transfer protocol,* programs enable any two computers connected to the Internet to transfer files. A Web browser, terminal emulation program, or FTP program may be included within another application program.

Local area networks (LAN's) serve users within a limited area, such as an office building or a college campus. A LAN is made up of servers, workstations, a network operating system, and a communications link. Often, the workstations have no hard drives or other storage devices. Such machines, called *thin clients,* retrieve all the software and data they use from the server. A printer or other peripheral can be attached to a server for network users to share, or it can be connected so that it works with only one workstation.

Any computer connected to the network may be considered a client if it uses a resource on another computer. Any computer linked to the network can be considered a server if it manages a resource for its clients. A computer that manages all of the printers within the network is called a *print server.* A computer used by workstations for heavy computation tasks is called a *compute server.* Rugged, highly reliable computers that perform no task other than serving the needs of the network are called *dedicated servers.* A large network may use several such machines.

A small LAN need not have a dedicated server. Instead, every machine linked to the network allows ac-

cess to its data by users on other machines. Such a system is known as a *peer-to-peer* network.

Wide area networks (WAN's) are communications networks that cover a wide geographic area, such as a state or country. LAN's can be connected together by devices called *routers* to form a WAN.

Intranets are Web sites that serve the employees of a particular business or organization. Intranet pages may connect to the Internet through a secure link called a *firewall*. A firewall prevents ordinary Internet users from gaining access to an intranet.

Extranets are networks operated for businesses to link together such contacts as customers, partners, and suppliers. An extranet is available through a Web site. Extranets provide access to research, current inventories, internal databases, and other information that is private and not published for everyone. An extranet uses the Internet as its transmission system, but users must supply a password to gain admission to a site. Access to the site may be free, or the network owner may require payment for some or all of the offered services.

Programming a computer

Computer programming is the preparation and writing of detailed sets of instructions for a computer. Computer specialists called *programmers* write most of these sets of instructions, which are commonly called *programs*. To write their programs, these experts use programming languages, which generally consist of words, individual letters, numerals, and other symbols, as well as rules for combining those elements.

Preparing a program begins with a complete description of the job that the computer is to perform. This description explains what data must be input, what computing must be done, and what form the output should take. Computer programmers use the description to prepare diagrams and other pictorial aids that represent the steps needed to complete the task. The programmers may produce a diagram called a *systems flow chart* that shows how all the major parts of the job fit together. The program itself is then typed into a *text editor*, a program used to create and edit text files, and saved onto a disk or other storage medium.

Using programming languages. Most programmers write their programs using *high-level languages*. Such languages often include symbols, everyday expressions, or mathematical formulas. The language a programmer uses depends largely on the job to be done. For example, if a task involves processing business data, the programmer would likely use COBOL (*CO*mmon *B*usiness *O*riented *L*anguage). Programming a computer to solve complicated scientific problems might require the use of a mathematically oriented language, such as Fortran (*For*mula *tran*slation). COBOL and Fortran were among the earliest of the high-level languages.

Other commonly used high-level languages include BASIC (*B*eginner's *A*ll-purpose *S*ymbolic *I*nstruction *C*ode), Pascal, C, C++, and Java. BASIC is well suited for writing relatively simple programs for PC's. Pascal is a simple language that is popular for teaching programming.

New languages are constantly being developed. They often build on other languages. For example, Visual Basic builds on earlier versions of BASIC. Java, which was developed for new computer functions, draws from both C and C++. Java was designed to allow programs to run on any computer that has a piece of software called a *Java interpreter*. Many older languages have become obsolete and are no longer used.

Some programming languages, such as C++, support the use of *objects*. An object includes a block of data and the functions that act upon those data. *Object-oriented programming* (OOP) uses objects that can work together to create a whole program. OOP relieves programmers of the need to re-create sections of code in long programs. The same object may also be used in more than one program. For this reason, making changes in the software is relatively easy.

Programmers sometimes write their programs in *assembly language*. This language is harder to use than a high-level language. The programmer must state each instruction with much more detail than is needed when using a high-level language.

Compiling or assembling a program. Computers appear to work directly with programs written in programming languages. But in most cases, before a program can be run, special *translator* programs must translate the programming language text into a *machine language*, or *low-level language*, composed of numbers. These numbers represent memory addresses and operation codes. Different types of computers use different machine languages. A program written for one type of machine may not run on another type. However, special *emulation programs* can be used on one type of computer to mimic the operation of another type. Such programs enable the computer to run software designed for the other type of system.

The programs used to translate most programming languages are called *compilers* and *assemblers*. A compiler typically translates one statement in a high-level language into several intermediate assembly language statements or directly to several machine language instructions. Each assembly language statement corresponds to a single machine language instruction. If a compiler has first translated the program to assembly language, an assembler must then translate the assembly language statements into machine language instructions.

Once a program has been permanently translated into machine language, it is saved as a file. Thus, when a user runs a program, he or she is actually instructing the operating system to load the machine language program into memory. The processor then reads and executes each translated instruction.

Some *integrated development environments* (IDE's) combine a text editor, a *debugger*, a compiler or an assembler, and a *loader* into the same program, which streamlines the process of developing a new program. Instructing the IDE to run a new program causes it to check the written program for *bugs* (mistakes), to translate the text into machine language, to load the machine language into memory, and then to instruct the processor to run the new program. When the new program has finished running, the integrated environment resumes execution

Interpreting a program. Some programs are run using a program called an *interpreter* instead of a compil-

er. The interpreter examines, translates, and performs each statement as it is encountered in the program. If program instructions "loop back" to an earlier point in the program, the earlier statements are examined, translated, and executed again. Programs that use interpreters run more slowly than those that use compilers.

Completing and distributing a program. After a computer program is written, it is *debugged*—that is, it is thoroughly tested for mistakes—and all detected problems are corrected. The programmer makes the corrections in the written program, and the program is again translated into machine code and tested. These processes are repeated until testing detects no errors or improper functions.

Once a program has been completely tested, debugged, and compiled into machine language, the compiler is no longer needed unless further changes must be made to the program. The file containing the machine language can be copied and distributed to anyone who needs the program. In most cases, the programmer's computer maintains the original text of the written program.

Computer security

Many people fear that possible misuse or unauthorized disclosure of information in computer databases threatens their privacy. Certain databases hold private and personal information, such as medical, banking, or tax records. Others contain business plans or inventions that a company wishes to conceal from competitors. Still others store top-secret military information and other kinds of data important to a nation's security.

Laws limit the disclosure of information in databases, and operating systems are designed to prevent unauthorized entry into a computer. Often, a computer user must enter a password. In addition, some computer systems automatically *encrypt* information—that is, translate it into a secret code—so that only authorized personnel can *decrypt* it—that is, translate it back into readable language. Home computer users can employ encryption software to protect personal information.

Sensitive information is encrypted when it will travel over a communications line that may not be secure. Internet businesses encrypt credit card numbers and other personal information so that a purchaser can safely transmit the information over the Internet. Only the intended recipient can decrypt the transmission. In a *public-key cryptosystem,* a mathematical technique is used to create a *key pair.* A key pair consists of a *private key* (code), which its user keeps secret, and a mathematically related *public key,* which is available to everyone. Anyone can use the public key to encrypt a message, but only the holder of the corresponding private key can decrypt it. A person may send a message with a *digital signature,* a computation of the person's private key and the message being sent. Another person using the corresponding public key can use this signature to verify the identity of the person who sent the message. It is practically impossible for an individual to determine a private key using the associated public key within a reasonable time.

Despite protective measures taken by businesses and individuals, computer crimes sometimes occur. Industrial spies and thieves often link their computers to a network to gain access to other computers on that network. Some of these criminals steal or change the information in a computer database. Others steal money by transferring funds electronically. Some wrongdoers can correctly guess poorly chosen passwords. Others run programs called *packet sniffers* on computers that handle Internet traffic, seeking to collect pieces of data as they are transmitted.

In the late 1980's, computer experts realized that software could be used to damage data stored on computers. Programs known as *viruses* are designed to do mischief, sometimes by deleting or changing information and sometimes by simply inserting a message. A virus can enter a computer's operating system through a network or a storage medium, such as a floppy disk or a CD-ROM.

Other destructive programs known as *e-mail bombs, Trojan horses,* and *worms* spread over the Internet. Software publishers have devised virus protection software to help users find and eliminate destructive programs from a computer. Most publishers of virus protection software update their programs when they detect new types of viruses. Customers can often download these updates over the Internet.

The computer industry

The manufacture, development, sales, and servicing of computer hardware and software make up one of the largest industries in the world.

Manufacturing. From a few dozen companies in the early 1960's, the computer industry has grown to tens of thousands of firms throughout the world. These companies manufacture computers and such peripheral equipment as modems and printers. In addition, they develop and publish software and provide computer supplies, such as magnetic disks. Many companies make computer components, including processors. Others make the circuit boards and cables used to create networks.

The largest computer manufacturer in the United States—and the world—is International Business Machines Corporation (IBM). Other leading U.S. computer makers include Apple Computer, Inc.; Dell Computer; the Hewlett-Packard Company; and Sun Microsystems Incorporated.

The largest computer manufacturers outside the United States are Fujitsu and NEC Corporation, both of Japan. The leading computer companies in Europe include Groupe Bull of France and Siemens AG of Germany. The largest software company in the United States and the world is Microsoft Corporation.

Research and development. The constant increase in computer power is a major reason for the computer industry's success. This increase has resulted from research and development at businesses and universities throughout the world. Continuing research seeks to produce even faster processors, swifter means of communications, storage media that can hold more information, and better ways to encrypt or to compress information. Data are compressed through special coding techniques that reduce the number of bytes needed to carry information. Most data compression techniques are *lossless,* which means that a compressed file can be expanded back into its original form without any loss of

information. But a few techniques are *lossy,* which means that some nonessential information is deliberately discarded to achieve greater compression.

Sales. Computers are sold in a variety of ways. Large manufacturers of computers have teams of sales professionals. These teams contact corporations and institutions to sell combinations of hardware and software.

Another method of selling computers involves a *value-added reseller* (VAR). A VAR buys computer systems and components from a variety of sources. It then assembles and sells finished products, often tailoring the equipment to a buyer's specifications. Most VAR's also include software with their computers.

Retail outlets play an important role in the sale of personal computers. Computer specialty stores, mail-order houses, and general merchandise stores also sell many computers. Much hardware and software is sold over the Internet.

Service and repair. Many computer manufacturers offer service contracts that provide for regular maintenance and prompt repair of their computers. Some large businesses and institutions have their own computer maintenance staffs.

Careers. There are many career opportunities in the computer industry. Computer engineers are probably the most technically specialized computer experts. Hardware engineers design the circuits that are engraved on chips, and they develop the wiring that lets information flow smoothly through the computer. Engineers also contribute to the design of memory, storage, input, and output equipment.

Computer scientists do research into operating systems, computer languages, robotics, computer vision and image processing, artificial intelligence, numerical analysis, and the theory of computation. Computer programmers write the instructions that make computers operate properly. Systems analysts determine the most efficient use of computers for particular situations. Software publishers issue programs, write and edit instruction manuals, and provide technical services for customers. Many publishers write manuals for software produced by other developers.

Many career opportunities exist outside the computer industry itself. Data processors who work for companies that use computers enter information into those computers. Workers in many factories oversee computers that control machines. Computer training is also an important industry.

Some of the computer industry's most successful individuals are self-taught. But most computer careers call for a college degree. College courses that help prepare students for careers in computers include programming, electrical engineering, systems analysis, and data processing.

History

The ideas and inventions of many engineers, mathematicians, and scientists led to the development of the computer. The first true calculating machines were developed in the 1600's.

In 1642, the French mathematician, scientist, and philosopher Blaise Pascal invented the first automatic calculator. The device performed addition and subtraction by means of a set of wheels linked by gears. The first wheel represented the numbers 1 to 10, the second wheel represented 10's, the third stood for 100's, and so on. When the first wheel was turned 10 notches, a gear moved the second wheel forward a single notch. The other wheels became engaged in a similar manner. In early versions of the machine, some wheels had 12 or even 20 notches, reflecting standard divisions among the denominations of French currency.

During the early 1670's, the German mathematician Gottfried Wilhelm Leibniz, who—along with the English scientist Sir Isaac Newton—is credited with developing calculus, improved Pascal's calculator. Leibniz added gear-and-wheel arrangements that made multiplication and division possible. Leibniz also developed the binary numeration system, a counting system that was easier for a machine to handle than the decimal system.

An important contribution to the development of binary mathematics was made in the mid-1800's by George Boole, an English logician and mathematician. Boole used the binary system to invent a new type of mathematics. *Boolean algebra* and *Boolean logic* perform complex mathematical and logical operations on the symbols 0 and 1. Thus, a mechanical representation of binary mathematics would require the representation of only those two digits. This advance shaped the development of computer logic and computer languages.

Early punched-card computing devices. Joseph Marie Jacquard, a French weaver, made the next great contribution to the development of the computer. In the weaving process, needles directed thread to produce patterns. Correcting a mistake made on a manual loom might mean undoing several weeks of work. During the 1700's, many people sought to eliminate such mistakes by automating the weaving process. In 1801, Jacquard succeeded. The Jacquard loom used long belts of punched cards to automate the weaving. The cards were placed between the rising needles and the thread.



U.S. Census Bureau

The punched-card tabulating machine invented by Herman Hollerith was the first successful computer. It was used to compute the results of the 1890 United States census.



ENIAC, completed in 1945, was one of the first general-purpose digital computers. The enormous machine was invented by J. Presper Eckert, Jr., *front left,* and John W. Mauchly, *center.*

Where there were holes, the needles rose and met the thread. Where there were no holes, the needles were blocked. By changing cards and alternating the patterns of punched holes, loom operators could mechanically create complex woven patterns. The presence or absence of a hole could be compared to the two digits of the binary system.

The punched cards of the Jacquard loom inspired the English mathematician Charles Babbage. During the 1820's, Babbage developed the idea of a mechanical computer. He worked on several versions of the machine for almost 50 years. He called early versions the *difference engine* and later versions the *analytical engine.* When performing complex computations or a series of calculations, his analytical engine would store completed sets of punched cards for use in later operations. Babbage's analytical engine contained all the basic elements of an automatic computer—storage, working memory, a system for moving between the two, and an input and output device. But Babbage lacked funding to build an analytical engine. In 1991, the Science Museum in London constructed an operational version of one of Babbage's difference engines from his original drawings.

Although Babbage never built an analytical engine, one of his contemporaries, Ada Lovelace, an English mathematician and the daughter of the poet Lord Byron, planned sequences of steps for the machine to perform. Many people consider her to be the world's first computer programmer.

The first successful computer. In 1888, the American inventor, statistician, and businessman Herman Hollerith devised a punched card system, including the punching equipment, for tabulating the results of the United States census (see Census). Hollerith's machines used electrically charged nails that, when passed through a hole punched in a card, created a circuit. The circuits registered on another part of the machine, where they were read and recorded. Hollerith's machines tabulated the results of the 1890 census, making it the fastest and most economical census up to that date. In a single day, 56 machines could tabulate census information concerning more than 6 million people.

Governments, institutions, and industries found uses for Hollerith's machine. In 1896, Hollerith founded the Tabulating Machine Company. He continued to improve his machines. In 1911, he sold his share of the company. Its name was changed to the Computing-Tabulating-Recording Company (C-T-R). In 1924, the name was changed to International Business Machines Corporation (IBM).

The first electronic computers. The first special-purpose electronic digital computer was constructed in 1939 by John V. Atanasoff, an American mathematician and physicist. During World War II (1939-1945), the German inventor Konrad Zuse designed and built two general-purpose electronic digital calculators that used electrical telephone relays. In 1944, Howard Aiken, a Harvard University professor, built a digital computer called the Mark 1. The operations of this machine were controlled chiefly by electromechanical *relays* (switching devices).

In 1945, two engineers at the University of Pennsylvania, J. Presper Eckert, Jr., and John William Mauchly, completed one of the earliest general-purpose electronic digital computers. They called it ENIAC (*E*lectronic *N*umerical *I*ntegrator *A*nd *C*omputer). ENIAC contained about 18,000 vacuum tubes instead of relays. The machine occupied more than 1,500 square feet (140 square meters) of floor space and consumed 150 kilowatts of electric power during operation. ENIAC operated about 1,000 times faster than the Mark 1. It performed about 5,000 additions and 1,000 multiplications per second.

Although ENIAC worked rapidly, programming it took a great deal of time. Computer specialists created programs by setting switches manually and plugging cables into the machine's connector panels. Eckert and Mauchly next worked on developing a computer that could store more of its programming. They worked with John von Neumann, a Hungarian-born American mathemati-



Apple Computer, Inc.

Computer pioneers Stephen G. Wozniak, *left,* and Steven P. Jobs introduced the Apple II computer in 1977, making computing economical for families, schools, and small businesses.

cian. Von Neumann helped assemble all available knowledge of how the logic of computers should operate. He also helped outline how stored programming would improve performance. In 1951, a computer based on the work of the three men became operational. It was called EDVAC (*E*lectronic *D*iscrete *V*ariable *A*utomatic *C*omputer). EDVAC strongly influenced the design of later computers.

Also in 1951, Eckert and Mauchly completed a more advanced computer called UNIVAC (*UNIV*ersal *A*utomatic *C*omputer). UNIVAC became the first commercially successful computer. Unlike earlier computers, UNIVAC handled numbers and alphabetical characters equally well. It also was the first computer system in which the operations of the input and output devices were separated from those of the computing unit. Like ENIAC, UNIVAC used vacuum tubes.

The first UNIVAC was installed at the U.S. Census Bureau in June 1951. The following year, another UNIVAC was used to tabulate the results of the United States presidential election. Based on available data, UNIVAC accurately predicted the election of President Dwight D. Eisenhower less than 45 minutes after the polls closed.

Miniaturization. The invention of the transistor in 1947 led to the production of faster and more reliable electronic computers. Transistors soon replaced the bulkier, less reliable vacuum tubes. In 1958, Control Data Corporation introduced the first fully transistorized computer, designed by the American engineer Seymour Cray. IBM introduced its first transistorized computers in 1959.

Computer technology improved rapidly during the 1960's. Miniaturization continued with the development of the *integrated circuit,* a complete circuit on a single chip, in the early 1960's. This device enabled engineers to design both minicomputers and high-speed mainframes with huge memories. By the late 1960's, many large businesses relied on computers. Many companies linked their computers together into networks, enabling different offices to share information.

By the early 1970's, the entire workings of a computer could be placed on a handful of chips. As a result, computers became smaller. The first microprocessor, developed by Intel in 1971, contained around 2,500 transistors. The Intel Pentium 4 microprocessor, released in 2000, contained 42 million transistors.

The personal computer. The first personal computer, the Altair, was introduced in kit form in 1975. Only electronics hobbyists bought these computers.

In 1977, two young American computer enthusiasts, Steven P. Jobs and Stephen G. Wozniak, founded Apple Computer, Inc., and introduced the Apple II personal computer. The Apple II was much less expensive than mainframes. It was sold as an assembled unit, not as a kit. As a result, computers became available to people other than computer specialists and technicians. Personal computers were purchased by small and medium-sized businesses that could not afford mainframes or

IBM Corporate Archives



The PC, the first personal computer manufactured by IBM, appeared in 1981. The PC incorporated components made by other manufacturers. Other computer makers used the same components to manufacture their own brands of personal computers.

did not need the immense computing power the mainframes provided. Millions of individuals, families, and schools also bought personal computers.

In 1975, former schoolmates Bill Gates and Paul Allen founded Microsoft Corporation to develop programs for the Altair. In 1981, IBM entered the personal computer market with its PC. The machine was even more successful than the Apple II. Microsoft soon began to develop programs for the PC. Apple scored another success in 1984 with the introduction of its Macintosh, a powerful, easy-to-use desktop computer.

As computer power increased, so did computer speed. Meanwhile, the size and cost of computers shrank steadily. As computers grew more powerful and their functions more varied, the size of computer programs grew dramatically. Some modern applications programs contain tens of millions of lines of programming instructions. William T. Verts

Related articles in *World Book* include:

Uses

Animation (Computer animation)
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Computerized instruction
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Engineering (Computer engineering)
Game (Electronic games; Internet games)
Guided missile (Kinds of guidance systems)
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Information science
Library (The growth of information and technology)
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Mechanical drawing (Creating a drawing)
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Multimedia
Photocomposition
Photoengraving and photolithography (Capturing the image)
Printing (Typesetting; Page makeup; Digital printing)
Railroad (At interchanges)
Systems analysis
Telemarketing
Virtual reality
Word processing

Biographies

Babbage, Charles
Berners-Lee, Tim
Eckert, J. Presper, Jr.
Gates, Bill
Hopper, Grace M.
Jacquard, Joseph Marie
Kilby, Jack
Leibniz, Gottfried Wilhelm
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Simon, Herbert A.
Turing, Alan M.
Von Neumann, John

Other related articles

Analog computer
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Modem
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Online service
Printer
Science fiction (Recent developments)
Sony Corporation
Spreadsheet
Telecommunications
Telephone (Routing the call; Transmitting data)
Transistor
Video game
Watch
Web site
World Wide Web

Outline

I. **Kinds of computers**
A. Personal computers
B. Mainframes and supercomputers
C. Dedicated computers
D. Embedded computers

II. **Computer code**

III. **Parts of computers**
A. Microprocessors
B. Memory chips
C. Input devices
D. Storage devices
E. Output devices

IV. **Computer software**
A. Operating system software
B. Applications software

V. **Computer networks**
A. The Internet
B. Local area networks (LAN's)
C. Wide area networks (WAN's)
D. Intranets
E. Extranets

VI. **Programming a computer**
A. Preparing a program
B. Using programming languages
C. Compiling or assembling a program
D. Interpreting a program
E. Completing and distributing a program

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E. Careers

IX. **History**

Questions

How does a read-only memory (ROM) chip differ from a random-access memory (RAM) chip?
What does a scanner do to a picture to enable a computer to process the image?
What is a graphical user interface?
What is machine language?
What are some methods and tools that people and businesses use to protect private information?
How do today's electronic computers differ from those developed in the mid-1900's?
What are the main uses of input, output, and storage devices?
How does a network interface card differ from a modem?
How are computers used in design? In medicine? In education?
What are the different kinds of computer networks? How do they differ?

Additional resources

Level I

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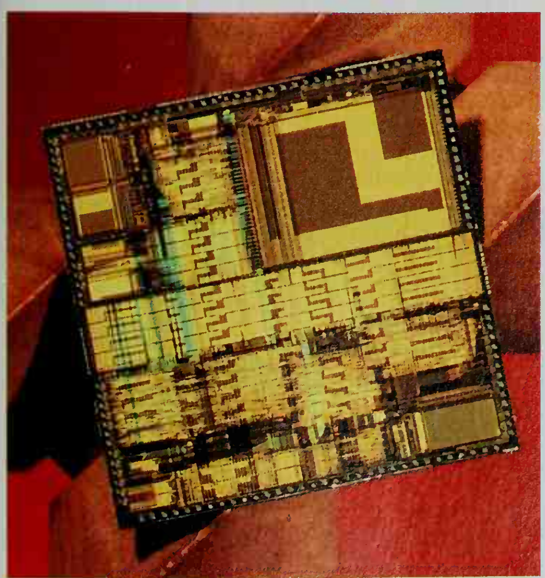
Level II

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Walters, E. Garrison. *The Essential Guide to Computing.* Prentice Hall, 2000.

Computer chip is a tiny piece of material, usually silicon, that contains a complex electronic circuit. These chips are essential in modern computers and a variety of other electronic devices. The circuit on a computer chip, sometimes called an *integrated circuit,* is made up of electronic components built into the chip. Most chips are no larger than a fingernail.

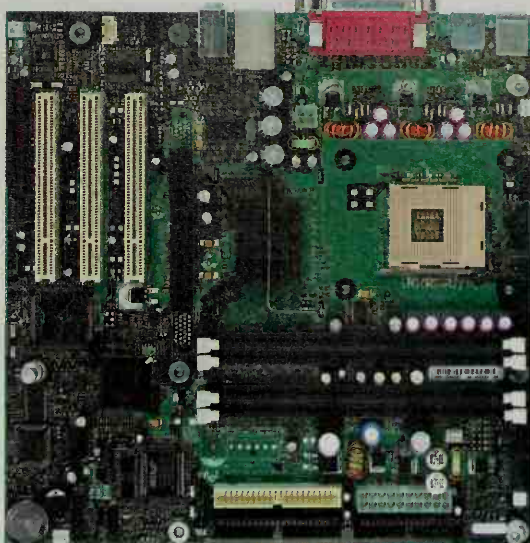
There are two main kinds of computer chips: (1) *microprocessors,* which carry out the instructions that make up computer programs, and (2) *memory chips,* which hold computer programs and data. Memory chips are used primarily in computers. Microprocessors are used in computers and hundreds of other products. A microprocessor serves as the "brain" of every personal computer. Larger computers have more than one such chip. Other products controlled by microprocessors include video games, digital watches, microwave ovens, and some telephones.

Structure. The body of most chips is made of silicon. This material is used because it is a *semiconductor.* In its pure form, silicon does not conduct electricity at room temperature. But if certain impurities are added to silicon, it can carry an electric current. Manufacturers "dope" silicon chips with such impurities as boron and phosphorus. The doped regions form the electronic components, which control the electric signals carried on the chip. The type and arrangement of the impurities determine how each component controls signals. Most components serve as switches called *transistors.* Others serve mainly as *capacitors,* which store an electric charge; *diodes,* which prevent current from flowing in one direction but not the other; and *resistors,* which control voltage.



IBM Corporation

A microprocessor is a chip that performs computer operations and holds some memory. This microprocessor measures 12.7 millimeters ($\frac{1}{2}$ inch) on a side.



© Intel Corporation

Chips on a *motherboard,* the main circuit board of a computer, are mounted inside square and oblong packages. Metal pins wired to each chip connect the packages to the motherboard.

Some chips contain millions of components. Certain parts of these components measure less than 1 *micrometer* (0.001 millimeter) across. Manufacturers create thin lines of metal—usually aluminum—on the chip to connect these tiny components.

External connections. Most chips connect with other devices by means of a container called a *package.* One common type of container is a *dual in-line package* (DIP), an oblong box 1 to 2 inches (2 to 5 centimeters) in length. Two rows of metal pins extend downward from the box, one from each long side. Each pin is connected by a wire to an electric terminal on the chip.

In a computer, the packaged chip is mounted on a circuit board. Printed circuits on the board connect the package—and thus the chip—with other devices.

Characteristics of microprocessors. Microprocessors perform essential computer operations. A microprocessor obtains instructions and data from an external memory device; performs arithmetic and logic operations with these data; and, after obtaining a result, moves the calculated data back to the external memory device.

Word length. Instructions and other data handled by computers are in the form of "words." A word is a group of *bits.* A bit is a *binary digit*—a 0 or a 1. Computers operate on the basis of bits. For example, the presence of

an electric charge in a capacitor can represent a "1" and the absence of a charge can represent a "0."

The maximum word length that a microprocessor can handle helps determine how rapidly it can operate. The earliest microprocessors used 4-bit words. As microprocessors advanced, they were able to handle longer words—usually made up of 8, 16, 32, or 64 bits.

Clock speed is another important characteristic of a microprocessor. Bits travel through a computer in pulses of electric current that occur at regular intervals called *clock cycles.* Today's microprocessors run at speeds measured in millions of cycles per second. One million cycles per second equals one megahertz (MHz).

Instruction sets. There are two basic types of microprocessors: (1) complex instruction set computer (CISC), and (2) reduced instruction set computer (RISC). Most personal computers use CISC chips. Many powerful workstations and some printers have RISC chips.

A CISC chip has a large instruction set—that is, it has many ways to carry out each instruction. For example, it may be able to add two numbers by following any one of 10 procedures. These procedures take various numbers of clock cycles. The number of cycles depends on such factors as the size of the numbers to be added and the location of the numbers in the computer system. A RISC chip uses instructions that are always the same length and can be executed in one clock cycle. By using its special circuits, a RISC chip can execute many times more instructions per second than can a comparable CISC chip.

Memory chips. Most computers use two main types of memory chips, though there are variations on each kind. The two main types are (1) read-only memory (ROM) and (2) random-access memory (RAM). A ROM chip retains its stored memory even when the computer is turned off, but the computer user normally cannot change the stored memory. In contrast, the user can change the memory stored in a RAM chip with each keystroke made. But the chip holds its memory only as long as power is on.

There are two main kinds of RAM: static RAM (SRAM) and dynamic RAM (DRAM). SRAM holds its memory until the microprocessor changes it, but DRAM can only hold its memory for a few thousandths of a second. Therefore, a DRAM chip must be *refreshed* regularly, or it will lose its data. To refresh a DRAM, the computer removes the information from each group of *cells* (memory storage units) in the chip, then puts the same information back. This may seem wasteful. But the time and expense involved are more than made up for by the amount of memory that can be fit into a small space on a DRAM and the cost of these devices. The majority of memory chips used in personal computers are DRAM's, because they are inexpensive to make and can store much memory.

Researchers have developed memory chips with useful features of both ROM and RAM chips. These *erasable ROM* chips can be erased and reprogrammed, yet they do not lose their memory when the computer is turned off. One successful design is the electrically erasable, programmable ROM (EEPROM) chip. A pulse of electric current can erase all the memory in a selected area of the chip. The user can then reprogram this area as if it were part of a RAM chip.

Chip manufacture begins with a wafer of doped silicon. The wafer measures from about 1 to 12 inches (25 to 300 millimeters) in diameter. A photographic process reduces a large master design for the integrated circuit to microscopic size. Technicians use these microscopic designs, called *masks,* as stencils to make hundreds of chips on one wafer. After the wafer has been processed, it is divided into individual chips.

History. The first computer chips were patented in 1959 by two Americans—Jack Kilby, an engineer, and Robert Noyce, a physicist—who worked independently. During the 1960's, scientists developed chips for guided missiles and satellites. Engineers soon began to build smaller and faster computers by using chips in place of conventional circuits. The first microprocessors were produced in 1971 for use in desktop calculators.

M. David Stone

Related articles in *World Book* include:

Capacitor
Computer
Electronics (Electronic circuits)
Kilby, Jack
Noyce, Robert
Photoengraving and photolithography
Smart card
Transistor
Video game

Computer graphics is a term that refers both to the use of computers to create or change images and to the images themselves. The images can be still pictures, such as a snapshot or diagram; or part of a moving picture, such as an animated cartoon, a music video, or a full-length movie. The image can appear on a flat screen; or, in a *virtual reality* system, it can be part of an artificial, three-dimensional environment that includes sound.

Uses of computer graphics

Computer graphics is used in a wide variety of fields, including science, engineering, medicine, entertainment, and advertising.

In science, computer graphics can help researchers produce images of objects that are too small to see without a microscope. For example, a scientist can produce an image of the DNA molecule, which plays a key role in heredity and cell development. Many programs designed for scientists can also produce animated images. These programs create a series of still pictures and then display them one after another. For example, an animation can show a scientist how a molecule fits together with other molecules.

Another kind of scientific program translates complex mathematical equations into multicolored, three-dimensional graphs. Scientists can use these graphs to gain insight into physical processes. A chemist might create a graph that shows the energy levels at which molecules react with one another to produce a certain substance. The graph might reveal how the substance could be produced with less energy.

In engineering, a still image can help a machine designer see how one part fits together with other parts. An animated image can *simulate* (represent) how parts will react to certain forces. For instance, an animation can show how an automobile's shock absorbers will move when the car is driven over a rough road.

To produce this simulation, an engineer would first enter into the computer a *model* (set of mathematical equations) describing how each part of the shock



Special effects created by computer graphics merge with a shot of an actor in the motion picture *The Mask.*

absorber would react to forces. The engineer would then enter numbers representing the driving conditions. The computer would apply the numbers to the equations and display the resulting pictures. The process of designing products or mechanical devices on a computer is called *computer-aided design* (CAD).

Designers also use computer graphics to produce *mechanical drawings.* These drawings are made precisely to scale, and specifications of dimensions, angles, and other measurements are written on them. The production of mechanical drawings on computers is called *computer-aided design and drafting* (CADD).

In medicine, computer graphics enables physicians to "see" inside the body. In computerized tomography (CT), for example, X rays scan a patient's body. Bone and tissue absorb some of the radiation. The remaining rays strike detectors, which send information on the intensity of the radiation to a computer. The computer uses this information to produce an image of a cross-section of the body.

In entertainment, computer graphics provides special effects that were once produced with models or puppets. In one application, computer-created images of dinosaurs move in a lifelike manner across a motion picture screen. Such images are often merged with action shots of actors. In addition, computer graphics produces the pictures for video games and some animated cartoons.

In advertising, artists use computer graphics to create eye-catching animations of products performing impossible feats. Mouthwash bottles dance across the screen. Automobiles turn into animals. An advertising artist would also use computer graphics to remove the glare from a window in a photo for a new car ad.

Other uses of computer graphics include aviation training, architecture, mathematics, and art. Military and civilian pilots use flight simulators with highly realistic computer-generated images. Computer-created images enable architects to view building designs in three dimensions. Mathematicians use computer graphics to construct complex shapes. For artists, computer graphics provides a new way to draw pictures in a rich variety of colors and textures.

How a computer creates images

A computer-created picture consists of many points of color called *picture elements,* or *pixels.* If you look closely at a computer screen, you can see the pixels. Pixels are so small that more than 1 million fit on some screens.

A computer calculates a color for each pixel. In one technique, the computer holds in its memory a



A computer-generated frame from an educational motion picture shows how groups of atoms fit together to form a molecule. The molecule shown is lysozyme, a substance found in human tears and other body fluids. Lysozyme can destroy many kinds of bacteria.

model of a scene, such as a room with a chair and a table. The computer determines what a viewer would see by looking through each pixel. To do this, the computer first calculates the direction of a line extending from the viewer's eye, through the pixel, and into the room. The computer next determines what point in the scene the line would strike, and then assigns the color of that point to the pixel. If the line were to hit the chair, for example, the pixel would display the color of the chair. Finally, the computer combines the information for all the pixels to create the image.

For most virtual reality systems, the program produces two small images. The user of the system wears a headset or helmet that shows the two images—one for each eye. As the user moves, the computer calculates what the user would see. These systems are not yet fast enough or accurate enough to make the scene appear real. Joel S. Welling

See also **Computer** (Graphics programs); **Map** (Production and reproduction); **Mechanical drawing; Virtual reality.**

Computerized instruction is the use of a computer system to provide or supplement a learner's education. The student sits at a computer terminal. The computer screen displays lessons, questions, or other information, often with accompanying pictures or sound. The learner reacts by typing responses on the computer's keyboard or by moving a handheld control device called a *mouse.*

Computerized instruction has several advantages. It is *interactive*—that is, the student's responses determine what happens next. The computer responds to the learner immediately, acknowledging correct answers and giving additional explanation if needed. When a teacher instructs an entire class, the information may be too hard or too easy for some students. With computerized instruction, each student works at his or her own pace and level of ability. Teachers who use computers to provide some instruction may have more time to give extra attention to students who need it. Computerized instruction can even provide teachers with detailed information about each student's progress.

Computerized instruction can help students at all levels, from preschoolers through adult learners. Businesses, government, and the armed forces include computerized instruction in their training programs. People also use computers at home to acquire new skills. For example, there are computer programs to help bridge and chess players improve their play. This article chiefly discusses computerized instruction in schools.

How computerized instruction works

To use a computer for instruction—or for any other purpose—a user needs *hardware* and *software.* The physical equipment that makes up a computer system is called hardware. Computer software, also called a *program,* tells the hardware what to do and how to do it. Many instructional programs are recorded on a type of disc called a CD-ROM (*C*ompact *D*isc *R*ead-*O*nly *M*emory), which can store large amounts of data. Multimedia programs combine text, images, animation, and sound. Multimedia CD-ROM's are a popular learning tool. Common features enable users to click the mouse on a word to see a definition or hear a pronunciation or view a related illustration or video clip.

Approaches to computerized instruction differ in the amount of instruction provided by the computer. In some cases, a teacher provides most of the instruction and asks students to operate a program to supplement the lesson. For example, a history teacher might ask students to use a program to learn about political campaigns before a class presentation on elections. In other cases, the computer provides most of the instruction. Schoolchildren can operate this type of program independently without a teacher. For example, students in remote or isolated communities can take advantage of such a program when a teacher is not available.

Types of programs

Educational programs are divided into groups according to the teaching methods they use. Different types of programs include *drill-and-practice programs, tutorials, instructional games, simulations,* and *resource programs.* Some of the programs combine teaching methods.

Drill-and-practice programs imitate flashcards. Students often use drill-and-practice programs to master material learned from a teacher or another source. Examples of drill-and-practice programs include multiplication drills and vocabulary practice programs.

Tutorials give a learner a small amount of information and then ask a question about the material. If the student answers correctly, the program presents new material and questions. If the student gives a wrong answer, the program explains the error. Students can use tutorials in all subject areas.

Instructional games enable students to win a computer game by using information that they have learned. Many instructional games use printed materials to supply the content that players must learn to win. Students often play instructional computer games in social studies classes. In one popular series of games, students look up answers to geography or history questions to chase a criminal around the world or through time.

Simulations are computer representations of realistic situations. Students make choices and watch how their choices affect outcomes. In one popular simulation, players design their own cities. Students decide how to provide public services, such as transportation and utilities. They determine how to use land and how much tax to charge residents. These decisions affect factors that influence the desirability of the city, including the cost of houses, the crime rate, and the amount of pollution.

Software companies often design simulations for mathematics, science, and social studies classes. Some schools have replaced science laboratories with simulations that enable students to perform experiments. For example, a biology class might learn anatomy from a simulated dissection of a frog instead of cutting up a real dead animal.

Resource programs give a learner access to *databases* (collections of useful information). Resource programs are a powerful tool for doing research. People can *search* (extract information from) databases in ways that meet their individual needs. For example, users can specify a subject or an author's name. One example of a resource program is an encyclopedia on CD-ROM, such as *The World Book Multimedia Encyclopedia.*

Databases may be *local* or *remote.* Local databases



IBM Corporation

Computers in the classroom provide a powerful learning tool. Educational software extends the ways in which students can investigate many subjects. Computers also enable students to work at their own pace and to explore individual interests.

are available only to one computer or to a *local area network* of computers that are connected to one another and share software. Remote databases, also known as *online databases* or *online resources,* are stored on a computer at a different location. Computer operators gain access to remote databases using a *modem* or other device that enables computers to communicate with each other over a network. After users search online databases, they often electronically copy information, or *download* it, to their own computer to examine later.

One of the most powerful and popular on-line resources is the Internet. The Internet is a vast computer network over which governments, universities, businesses, and individuals exchange information. Although the Internet contains a wealth of data, images, and sounds, finding specific information can be difficult. Because no overall authority checks the accuracy of information, users must evaluate Internet sources carefully.

Development of computerized instruction

Computerized instruction is based on a method of teaching called *programmed instruction.* Programmed instruction presents a sequence of material in small units that gradually increase in difficulty. Before computers were used for instruction, most programmed learning consisted of paper-and-pencil workbooks or tutorials. Students responded to questions and then were directed to different places in the tutorial, based on their answers. The students had to learn the material in one unit before they could go on to the next. Many students found tutorials awkward to use.

Early teaching machines. During the 1920's, researchers developed *teaching machines* that could deliver programmed instruction. The first teaching machine was a mechanical testing device that asked multiple-choice questions, one at a time. The machine did not present a new question until the student pressed the correct lever. By the early 1960's, teaching machines became more complex. The machines presented information on a small screen and used sound or light to indicate a correct response.

One of the first widespread uses of computerized instruction was PLATO (*P*rogrammed *L*ogic for *A*utomatic *T*eaching *O*perations), a project developed by the University of Illinois. It was the first instruction system that combined graphics with a touch-sensitive screen. By the early 1970's, many students were using PLATO instructional materials on large computers called *mainframes.*

The personal computer. Technological advances helped to produce smaller, faster, less expensive computers. By the late 1970's, electronics companies introduced *personal computers.* Unlike mainframes, personal computers were inexpensive enough for many individuals, families, and schools to purchase them. More students had access to computers, and they welcomed the novelty of computerized instruction. But most of the programs available at this time were poorly designed. Many were drill-and-practice programs that required lots of memorization and used the computer screen as if it were a piece of electronic paper.

In the 1980's, new computer technology helped to revolutionize software. Computer manufacturers developed faster computers with more memory and improved color screens. Computer programmers added more colors, attractive graphics, and lively animation. CD-ROM drives made it possible for programs to easily provide audio and video information. By the late 1980's, a technology called *graphical user interface* made most instructional programs easier to use. This technology enables users to give the computer instructions by selecting a picture called an *icon* rather than by typing commands.

Trends in computerized instruction. The importance of computers continues to increase in schools and throughout society. Computerized instruction can help students learn and also help them acquire computer literacy. Many experts feel that skill and confidence in using computers are some of the most essential lessons that education can provide. Because these skills are so important, equal access to computers has become a topic of public debate. Experts feel that society must find ways to make computers and other expensive technologies available to schools of all income levels.

The technology of computerized instruction continues to advance. Software engineers are working with *artificial intelligence* to design programs that—like good teachers—ask interesting questions and respond to creative answers. Artificial intelligence enables a computer to process information in a manner similar to the way a person thinks. In addition, some publishers have begun offering electronic books, also called *e-books,* that present textbook information through computers.

As computerized instruction becomes more widespread in schools, many educators expect the role of a teacher to change. In a classroom where computers are used extensively, the teacher may no longer be the main source of information. Instead, the teacher may act as a

facilitator, helping students locate, interpret, and share information. Ward Mitchell Cates

See also Audio-visual materials (Computers); Internet; Multimedia.

Additional resources

Crane, Beverley E. *Teaching with the Internet: Strategies and Models for K-12 Curricula.* Neal-Schuman, 2000.
Gooden, Andrea R. *Computers in the Classroom: How Teachers and Students Are Using Technology to Transform Learning.* Jossey-Bass, 1996.

Computerized tomography (CT). See Computed tomography.

COMSAT. See Communications Satellite Corporation.

Comstock Law is a United States law that prohibits the mailing of indecent materials or of information about birth control or abortion. The law, passed in 1873, is named for Anthony Comstock, a controversial reformer who crusaded for its passage.

The legislators who enacted the Comstock Law probably intended that it be used to prosecute pornography distributors in criminal court. Instead, it was used to support a system of administrative censorship by postal officials, without going to court. For about 85 years, postal officials used the Comstock Law, sometimes very loosely, to censor mail. If post office inspectors decided a book, picture, or other item of mail was indecent, they seized all copies and refused to deliver them.

Since the mid-1900's, the Supreme Court of the United States has narrowed the legal definition of pornography in the process of interpreting the First Amendment to the Constitution. The court also has placed constitutional limits on censorship. The Comstock Law is still in force, but most experts think the Supreme Court would find the system of postal censorship unconstitutional if it were challenged. As a result, the U.S. Postal Service almost never uses the law to seize mail, and the Department of Justice rarely tries to enforce the act in criminal court. James C. N. Paul

See also Obscenity and pornography.

Comstock Lode was the greatest silver-mining center in the United States during the 1800's. Its rich deposits, which included valuable supplies of gold, lay in west-central Nevada. Mines on the Comstock Lode flourished from 1859 to 1865 and again from 1873 to 1882. During this second period, a body of ore known as the Big Bonanza produced silver and gold ore worth more than $100 million. The mining area was named for Henry T. P. Comstock, a prospector who took credit for its discovery. But other miners really found the ore first.

The huge wealth of the Comstock Lode drew many people to the western part of Nevada. Virginia City developed near the mines and quickly became one of the most prosperous cities in the West. Duane A. Smith

See also Nevada (History); Virginia City.

Comte, *kawnt,* **Auguste,** *oh GOOST* (1798-1857), was a French social thinker and philosopher. He founded the philosophy of Positivism and originated a concept of social science known as *sociology.*

Comte sought to discover the laws that he believed governed the evolution of the mind. In his six-volume work, *The Course of Positive Philosophy* (1830-1842), he framed his "law of the three states." This law advanced the idea that people try to understand phenomena in three ways. Comte believed that people first seek a *theological* (supernatural) explanation; then a *metaphysical* (abstract) explanation; and finally a *positive* explanation. The positive explanation is derived from an objective examination of the phenomena. Comte believed that students should concern themselves only with phenomena that have an objective, "positive," existence. This belief forms a basis of Positivism.

Comte regarded all social thought as an interrelated whole, the laws of which can be found by assembling what he considered the facts. Comte's ideas have influenced students of historical and social theory, and of criminology, and such authors as Herbert Spencer and John Stuart Mill, who were seeking a "science of society." Comte was born at Montpellier, France.

Stephen A. Erickson

See also Positivism; Sociology (History).

Conakry, *KAHN uh kree* (pop. 705,280), is the capital, largest city, and chief port of Guinea. For the location of Conakry, see Guinea (map). The oldest part of Conakry lies on the island of Tombo, just off the coast. This area features low, whitewashed buildings with red-tiled roofs. The newer part of Conakry is on the mainland. It has modern office buildings and extensive areas of inexpensive housing. The city is a shipping, educational, and government administration center. Its products include beverages, lumber, metal goods, and processed foods.

Conakry was a small fishing village when the French took control of Guinea in the late 1800's. France made Conakry a major port and administration center. Guinea gained independence from France in 1958. Since then, Conakry has grown rapidly, and overcrowding has become a problem. Lansiné Kaba

Conant, *KOH nuhnt,* **James Bryant** (1893-1978), was an American chemist, educator, and government official. He was a pioneer in the development of organic chemistry theory. As a professor at Harvard University, Conant conducted research that led to an understanding of the structure and function of chlorophyll and hemoglobin molecules.

From 1933 to 1953, Conant served as president of Harvard University, where he introduced various educational and institutional reforms. He promoted a program of common core general education for all students at Harvard. During World War II (1939-1945), he chaired the National Defense Research Committee and worked as a scientific adviser on the project that developed the atomic bomb.

From 1953 to 1957, Conant was United States ambassador to West Germany. He later returned to the United States and conducted a study of the country's high schools. Conant's recommendations brought changes in the administration of secondary education. His suggestions also changed the teaching of mathematics, science, and foreign languages.

Conant was born in Dorchester, Massachusetts. His autobiography, *My Several Lives: Memoirs of a Social Inventor,* was published in 1970. Martin D. Saltzman

Concentration camp is a place where people are imprisoned, and in some cases killed, without legal proceedings. Many countries have imprisoned people in concentration camps because of their political views, religious convictions, ethnic background, or social attitudes. The best-known camps were those operated by the Nazis during the Holocaust, a campaign of systemat-



In a Nazi concentration camp, prisoners often were forced to work long hours under cruel conditions. The women shown here are inmates of Ravensbrück, a Nazi camp that existed in the late 1930's and early 1940's in northeastern Germany.

ic murder waged against Jews and others during World War II (1939-1945). The Nazis imprisoned and killed millions of people in such camps, first in Germany and later in German-occupied Europe.

Nazi concentration camps were created soon after Adolf Hitler came to power in Germany in 1933. The Nazis established the first permanent camp in Dachau, Germany, near Munich, in March 1933. Nazi camps held socialists, Communists, and other political prisoners; Jews; homosexuals; priests and ministers; and many others. After World War II started in September 1939, the Nazis increasingly used camp inmates for slave labor.

In 1941, the Nazis began to build *Vernichtungslager* (death camps). These camps were established for the purpose of killing Jews with poison gas and other methods. By the end of 1942, the Nazis had created six death camps, all in German-occupied Poland—Auschwitz, Belzec, Chelmno, Majdanek, Sobibor, and Treblinka.

The most notorious of these death camps was the camp at Auschwitz. During World War II, the Nazis murdered about 1 $\frac{1}{4}$ million people there. The victims included Jews, Poles, Gypsies, and Soviet prisoners of war.

Auschwitz was not just a death camp. It also contained a slave labor complex. When prisoners arrived at Auschwitz, the Nazis took their clothes and other possessions. The camp officials sent the old and the very young, women with children, the handicapped, and the weak directly to gas chambers. Able-bodied prisoners worked in the slave labor complex. When they became weak or ill, the guards killed them or forced them to work until they died. After the prisoners were dead, the Nazis removed any gold teeth from the corpses and burned the bodies.

Other concentration camps. From 1942 to 1946, the United States government imprisoned more than 110,000 Japanese Americans, including more than 70,000 U.S. citizens, in camps called *internment camps.* The United States and Japan were at war, and U.S. officials believed, with little evidence, that Japanese Americans threatened national security.

In the Soviet Union, concentration camps were part of the *Gulag* prison system. Gulags housed people who spoke out against the Communist government. At least 17 million people were sent to Gulags in the Soviet Union from 1928 to 1953. More than 12 million prisoners died at a Soviet camp called Perm-36 in the Ural Mountains. Communist governments in Vietnam, North Korea, and China have also held thousands of political prisoners in gulags.

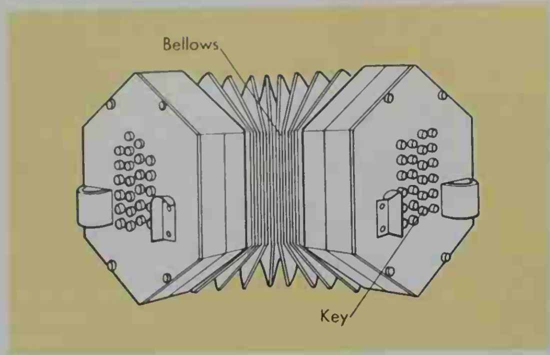
The term *concentration camp* was first used in 1900 to describe the open-air camps in South Africa where the British kept Boer prisoners of war. The British fought the Boers, South African settlers of mainly Dutch ancestry, during the Boer War (1899-1902).

Throughout history, many countries at war have established concentration camps to imprison members of enemy groups or nations. In the mid-1990's, for example, during the conflict in Bosnia-Herzegovina, each of the warring factions—Serbs, Muslims, and Croats—established concentration camps. Aaron T. Kornblum

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Dachau
Holocaust (The camps)
Mengele, Josef
Treblinka

Concertina, *KAHN suhr TEE nuh,* is a musical instrument in which metal reeds are made to vibrate by air pressure produced by opening and closing a bellows. Small keys or plugs in the end plates of the instrument open valves that control the reeds. The treble concertina used the most is a small, six-sided instrument with a range of about 3 $\frac{1}{2}$ octaves. There are also tenor, bass,



WORLD BOOK illustration by Oxford Illustrators Limited

A concertina consists of metal reeds inside a bellows. Keys or plugs in the end plates open valves that control the reeds.

and contrabass concertinas. The British inventor Sir Charles Wheatstone patented the concertina in 1829.

Valerie Woodring Goertzen

See also **Wheatstone, Sir Charles.**

Concerto, *kuhn CHEHR toh,* is a musical composition played by one or more solo instruments and an orchestra. A concerto resembles a symphony in form. But most concertos have only three *movements* (sections), and most symphonies have four.

The concerto developed from the *concerto grosso* of the late 1600's and early 1700's. The concerto grosso featured a group of soloists playing with an orchestra.

During the late 1700's, Wolfgang Amadeus Mozart wrote concertos in three movements. In the first movement, the orchestra states many of the work's themes before the soloist begins. Near the end of the movement is the *cadenza,* in which the soloist plays alone and displays his or her technical skill. In the second and third movements, the soloist and orchestra play together. The second movement is slow, and the third is fast.

During the 1800's, two types of concertos became popular. One was the *symphonic concerto,* in which the soloist and orchestra participate equally. Ludwig van Beethoven and Johannes Brahms composed concertos of this type. The other type was the *virtuoso concerto,* in which the orchestra accompanies the soloist. Niccolò Paganini, Franz Liszt, and Frédéric Chopin wrote virtuoso concertos. Composers of the 1900's generally followed Mozart's form. These composers include Béla Bartók, Sergei Prokofiev, and Igor Stravinsky.

R. M. Longyear

Conch, *kahngk* or *kahnch,* is any large sea snail with a heavy, spiral shell. Conchs live mainly on the floor of tropical seas. There are many kinds of conchs. But in North America, the word *conch* most commonly means the *queen conch,* also called the *pink conch.* This conch ranges from Bermuda, the Bahamas, and the Florida Keys to the West Indies. It grows to a length of about 1 foot (30 centimeters).

The queen conch has a soft body with a long, muscular organ called a *foot.* It uses its *operculum*—a pointed, hornlike part at the back end of the foot—to pull itself along. The shell varies widely in color—from white through pink, yellow, and orange—and has hornlike knobs. The queen conch feeds on seaweed and plant fragments on the sea floor. After mating, the female lays



Jane Burton, Bruce Coleman Ltd.

A conch is a large sea snail with a spiral shell. The *queen conch, shown here,* lives on the floor of the Atlantic Ocean from Bermuda to the West Indies.

a string of about 500,000 eggs. The eggs hatch after a few days. The tiny young float in the sea for several weeks before they settle on the bottom.

The flesh of the queen conch is valued as food and as fish bait. For thousands of years, people have used conch shells as trumpets. The shells also can be burned to make lime or ground up to make porcelain. They are prized by shell collectors. The overfishing of conchs has sharply reduced their numbers. Robert Robertson

Scientific classification. Conchs are in the phylum Mollusca, the class Gastropoda, and the subclass Prosobranchia. The scientific name for the queen conch is *Strombus gigas.*

See also **Mollusk; Shell** (picture); **Snail.**

Concord, Massachusetts (pop. 16,993), is noted for its historic and literary attractions. The town lies 19 miles (31 kilometers) northwest of Boston (see **Massachusetts** [political map]). Its largest industries make electronic test equipment and do metallurgical research. The Concord grape originated there. Welch Foods Incorporated, a maker of fruit products, has its headquarters there.

A group of English Protestants called Puritans founded Concord in 1635. Concord became a center of revolutionary activity and a storage area for military supplies. Volunteers from the surrounding countryside called *minutemen* rallied to oppose British forces searching for these supplies. The patriots exchanged shots with British troops in a brief battle at Concord's North Bridge on April 19, 1775. The fight, which the poet Ralph Waldo Emerson called "the shot heard round the world," was one of the opening battles of the Revolutionary War in America. Today, a replica of the bridge and a statue called *The Minute Man* by Daniel Chester French mark the battleground (see **Concord, Battle of**). The site is part of Minute Man National Historical Park.

Concord was a center of American writing in the 1800's. Emerson, Louisa May Alcott, Nathaniel Hawthorne, and Henry Thoreau lived there. People may visit the Emerson House; Orchard House, where Alcott wrote most of *Little Women;* the Old Manse of Hawthorne; and Wayside, where he lived. Concord Museum

displays period rooms of the 1600's to the 1800's. Nearby is Thoreau's Walden Pond. Concord is governed by an open town meeting, a board of selectmen, and a town manager. Laurence A. Lewis

Concord, New Hampshire (pop. 40,687), is the capital and one of the largest cities of the state. It is located on the Merrimack River in south-central New Hampshire (see **New Hampshire** [political map]). Called Penacook when it was founded in 1727, it took the name Rumford in 1733 and assumed its present name in 1765. Concord became the state capital in 1808.

Concord is the seat of Merrimack County. Government is the city's chief employer. The state, county, and city governments provide many jobs. Other major employers are in the fields of medicine, law, electronics, printing, and insurance. The city is home to the New Hampshire Technical Institute, the Franklin Pierce Law Center, the Christa McAuliffe Planetarium, and the state library and historical society. A home and the burial place of President Franklin Pierce are also located in the city. Concord has a council-mayor government.

Mike Pride

See also **New Hampshire** (Land and climate; picture: State Capitol).

Concord, Battle of, took place at Concord, Massachusetts, on April 19, 1775, and marked the second clash between the patriots and the British in the Revolutionary War in America. The opening battle was fought earlier the same day at nearby Lexington, Massachusetts. During the previous winter, the Americans had gathered military supplies in case of war. The British government ordered its commander in chief in America, Lieutenant General Thomas Gage, to take military action against Massachusetts patriots. On the night of April 18, Gage sent 700 troops from Boston under Lieutenant Colonel Francis Smith to capture and destroy the supplies at Concord. But patriot riders, including Paul Revere, William Dawes, and Samuel Prescott, warned the countryside that the British were coming.

After a clash at Lexington early the next morning, the British continued on to Concord, 6 miles (10 kilometers) beyond Lexington. The Americans retreated across North Bridge, outside Concord. The main force of British troops searched for the patriots' supplies in the town, while others guarded the bridge. Several hundred colonists marched on the bridge and exchanged shots with the British troops. Three British soldiers and two Americans were killed. A few hours later, the British troops headed back toward Boston. Fighting continued along the way, with about 250 British and about 90 Americans killed or wounded. The British casualties were the first suffered by Britain in the war.

Donna J. Spindel

See also **Revolutionary War in America** (picture).

Concorde. See **Airplane** (Supersonic airplanes).

Concrete. See **Cement and concrete.**

Concussion is a temporary disturbance of brain function caused by a sudden blow to the head. A concussion typically results in a temporary loss of consciousness, followed by a memory loss for the events just before and after the injury. More extensive memory loss occurs if the injury is severe. A mild concussion may or may not involve unconsciousness and memory loss. It causes a momentary state of confusion.

In a concussion, the blow causes the brain to bounce against the inside of the skull, injuring the brain's outer surface. Injury to the inner parts of the brain may also occur. The reason unconsciousness occurs is not well understood. One theory is that the blow disturbs function of the *cerebral cortex* (the outermost part of the brain). Another theory is that the blow injures the deeper parts of the brain that control sleep cycles and alertness.

The victim of a concussion may stop breathing for a few seconds after suffering the blow. In addition, the victim's pulse slows, the muscles relax, the pupils widen, and certain reflex actions disappear. As a result, a victim who is standing may fall down. Usually, the injured person regains consciousness within a few seconds. In more severe injuries, the person may not regain full alertness for several days. After a concussion, some people develop dizziness, headaches, ringing in the ears, or changes in behavior. They also may have difficulty concentrating. Such problems may affect the person for months. For information on how to treat the victim of a concussion, see **First aid** (Concussion).

Richard D. Penn

Condensation. See **Dew; Distillation** (with diagram).

Condensed-matter physics. See **Solid-state physics.**

Condom. See **Birth control** (Methods of birth control).

Condominium, *KAHN duh MIHN ee uhm,* is a type of multifamily housing in which each dwelling is a separate piece of real estate. The owners of the dwellings—in almost all cases, the people who live in them—own in common the halls, stairways, grounds, and other areas used by all the residents.

Condominiums attempt to combine the advantages of owning a single-family home with those of renting an apartment. For example, owners of condominiums receive the same tax advantages as homeowners. They also share expenses for services used by all the residents.

Condominiums can benefit communities by increasing property taxes, which provide funds for public services. However, people who cannot afford to buy their dwellings are forced out of their homes by the conversion of such units to condominiums. The conversion of rental apartments to condominiums also reduces the number of available rental units. This reduction leads to an increased demand for the remaining rental housing and therefore to higher rents.

Albert Hunter

See also **Housing** (Condominium housing).

Condor is either of two large vultures found in the Western Hemisphere. The *California condor,* which once lived wild in southern California, is nearly extinct. Only about 180 California condors survive, most of them in captivity. The *Andean condor* of South America is more common, but it also is in danger of extinction. Andean condors live in the Andes Mountains and along the coast of Peru and Argentina.

Appearance. California condors are the largest flying land birds in North America, with a wingspan of 8 to 9 $\frac{1}{2}$ feet (2.4 to 2.9 meters). They weigh up to 23 pounds (10.4 kilograms). The Andean condor has a wingspread of about 10 feet (3 meters) and weighs up to 26 pounds (12 kilograms). Black feathers cover most of an adult

condor's body. California condors have white on the underside of the wings. The upper wing surface of Andean condors is white. A collar of feathers circles the base of the neck—black feathers on California condors and white feathers on Andean condors. The featherless neck and head are red-orange in California condors and dark blue in Andean condors. Male Andean condors have a fleshy crest on the head.

Habits. In the wild, condors spend much of the day resting on high perches. Condors do not build nests. Instead, their eggs are laid in caves, in holes, or among boulders. A female California condor lays just one egg every two years. A female Andean condor also reproduces only every second year, laying one or two eggs.

Condors are powerful, graceful fliers. They can soar and glide for long distances, flapping their wings an average of only once an hour. They may search the ground for food as they fly. Like other vultures, condors eat the remains of dead animals.

Outlook for the California condor. By the 1980's, only a small number of California condors survived. Many California condors had been shot. Others died from lead poisoning after eating the remains of animals that had been shot with bullets containing lead. Still others may have died from eating poisoned animal bodies set out to kill coyotes. Increasingly, the growth of urban areas posed a major threat to condor survival. The condor's way of life requires vast areas of open, hilly country, and urban growth destroys such habitat.

In 1982, biologists began a program to capture all wild California condors. The last wild California condor was captured in 1987. Since then, more than 150 condors have been born and raised in captivity. In 1992, biologists began to release some of these condors into the wild. Richard D. Brown

Scientific classification. Condors belong to the New World vulture family, Cathartidae. The California condor is classified as *Gymnogyps californianus.* The Andean condor is *Vultur gryphus.*

See also **Bird** (picture: Protecting species); **Vulture.**

Condorcet, *kawn dawr SEH,* **Marquis de** (1743-1794), was a French philosopher. His major work was *Sketch for a Historical Picture of the Progress of the Human Mind* (1793-1794). He believed that human nature could be perfected and that history showed humanity's progress toward an enlightened civilization. He opposed monarchy and religion. He felt that evils resulted from inadequate institutions and laws created by rulers and priests. Condorcet believed that history up to his time consisted of nine *epochs* (periods). In the 10th epoch, which he projected for the future, equality would develop among nations and classes, and people would improve physically, intellectually, and morally.

Condorcet was born on September 17, 1743, in Picardy. His given and family name was Marie Jean Antoine Nicolas de Caritat. He was a brilliant mathematician, and he was elected to the French Academy.

Condorcet supported the French Revolution and served in the revolutionary Legislative Assembly and

WORLD BOOK Illustrations by Albert E. Gilbert



California condor
Gymnogyps californianus
Found mainly in captivity
Body length 50 inches
(127 centimeters)

Andean condor
Vultur gryphus
Found in the Andes, from Venezuela and Colombia to the Strait of Magellan.
Body length 52 inches
(132 centimeters)

Convention. But he was arrested as an enemy of the revolution. He committed suicide in prison on March 29, 1794. James Creech

Conduction. See **Heat** (How heat travels).

Conductor, Electrical. See **Electric current.**

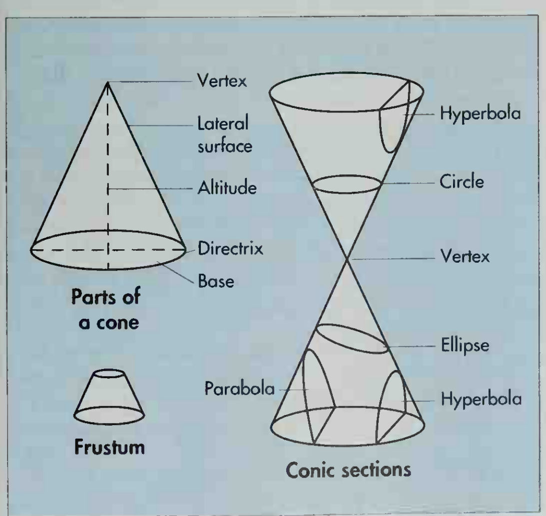
Cone, in geometry, is a solid figure whose base lies on a plane and is bounded by a closed curve called the *directrix.* The *lateral surface* (side) of the cone consists of all the line segments connecting points of the directrix to the cone's *vertex,* a fixed point not on the plane of the base. When the directrix is a circle, the cone is a *circular cone.* If the line segment from the vertex to the center of the circle is perpendicular to the plane of the base, the cone is a *right circular cone.* When a right circular cone is intersected by a plane that does not contain the vertex, a curve called a *conic section* is formed. Circles, ellipses, hyperbolas, and parabolas are conic sections.

The *altitude* of a cone is the perpendicular line segment from the vertex to the plane of the base. The length of the altitude is the *height* of the cone. The *volume (V)* of a cone can be found by using the formula: $V=\frac{1}{3}Bh$. In the formula, B stands for the area of the base and h for the height of the cone. If the base of the cone is a circle, then $B=\pi r^2$, where r is the radius of the circle. The formula for volume can then be written: $V=\frac{1}{3}\pi r^2 h$. An approximate value for π (pi) is 3.1416.

In a right circular cone, all the line segments from the vertex to the directrix have the same length, called the *slant height.* The *lateral surface area (L)* of a right circular cone can be calculated with the formula: $L=\pi rs$. In this formula, r stands for the radius of the base and s stands for the slant height. The *total surface area* of the cone equals the lateral surface area plus the base area.

If a plane parallel to the base of a cone passes between the vertex and the base, the cone is divided into a smaller cone and a solid figure called a *frustum.* The volume of the frustum equals that of the original cone minus the volume of the smaller cone. John K. Beem

See also **Circle; Ellipse; Hyperbola; Parabola.**



WORLD BOOK diagram by Linda Kinnaman

A cone is a solid figure. If the top of a cone is cut off by a plane parallel to the base, a solid called a *frustum* remains. *Conic sections* are curves formed by planes intersecting cones.

Conestoga wagon was a sturdy, colorful wagon used by American pioneers. The wagon was named for the Conestoga Valley in Pennsylvania, where it was first built during the early 1700's. Conestoga wagons carried most of the freight and people that moved westward over the Allegheny Mountains from the 1770's until about 1850. These wagons were sometimes called the *camels of the prairies.*

Both ends of the wagon were built higher than the middle. A high, rounded, white canvas roof could be put on the vehicle, making it a *covered wagon.* Wheels with broad rims prevented bogging down in mud. Conestoga wagons were drawn by teams of from four to six horses. Odie B. Faulk

See also **Pennsylvania Dutch; Western frontier life in America** (picture); **Westward movement in America** (picture).

Coney. See **Hyrax.**

Confederate States of America was the name taken by six Southern states when they organized their own government at Montgomery, Alabama, in February 1861. The states *seceded* (withdrew) from the government of the United States in 1860 and 1861 because they feared that the election of Abraham Lincoln, a Republican president, might lead to restrictions on their right to do as they chose about the question of slavery. The first state to leave the Union was South Carolina on Dec. 20, 1860. Mississippi, Florida, Alabama, Georgia, and Louisiana left the Union in January 1861. In February 1861, Texas seceded, and later in that year Virginia, Arkansas, North Carolina, and Tennessee seceded to make 11 Confederate States.

The idea of a state leaving the Union was not new, and the South did not invent it. Throughout the United States, people who believed in the doctrine of states' rights had long argued that any state had the right to withdraw from the Union whenever it chose. They argued that individual states had formed the Union and therefore could also dissolve it. Some people in the New England states wanted to leave the Union during the War of 1812, because the war was unpopular there.

Government. Organization of a government for the Confederacy began on Feb. 4, 1861, when delegates from the six states that had seceded by that time met at Montgomery, Alabama, and set up a temporary government. Jefferson Davis of Mississippi was elected president of the Confederacy, and Alexander H. Stephens of Georgia was chosen vice president. Both were to serve for one year. After the adoption of a permanent constitution, they were elected to six-year terms. Six prominent Southerners became members of the first Cabinet, and Montgomery was named the temporary capital. After Virginia seceded, the Confederate Congress voted on May 21, 1861, to move its capital to Richmond. The move was accomplished on May 29.

The Constitution of the Confederacy, adopted in March 1861, was modeled after the United States Constitution. But it contained six important differences:

1. The president's and vice president's terms were six years. The president could not serve successive terms.
2. Cabinet members received seats in Congress and had the privilege of debate. But they could not vote.
3. Foreign slave trade was ended, but not slavery.
4. Congress was forbidden to make appropriations

Confederate Cabinet

Office	Holders
Secretary of state	Robert Toombs (1861) Robert M. T. Hunter (1861) Judah P. Benjamin (1862)
Secretary of the treasury	Christopher Memminger (1861) George A. Trenholm (1864)
Secretary of war	Leroy P. Walker (1861) Judah P. Benjamin (1861) George W. Randolph (1862) Gustavus Smith (Acting) (1862) James A. Seddon (1862) John C. Breckinridge (1865)
Secretary of the navy	Stephen R. Mallory (1861)
Postmaster general	John H. Reagan (1861)
Attorney general	Judah P. Benjamin (1861) Thomas Bragg (1861) Thomas Watts (1862) George Davis (1864)

for internal improvements, to levy a protective tariff, or to give bounties.

5. A two-thirds vote of both houses of Congress was necessary to admit a new state into the Confederacy or to make appropriations not requested by the heads of departments through the president.

6. The president could veto single items in appropriation bills.

The Confederate States hoped for a peaceful withdrawal from the Union. A number of persons in the Confederacy and in the Union worked hard to avoid war. But their efforts failed, and war began with the attack on Fort Sumter on April 12, 1861.

The border states were the slave states that lay between the North and the Deep South. When the war began, both the Union and the Confederacy made strong efforts to gain their support. North Carolina, Virginia, Arkansas, and Tennessee joined the Confederacy. Delaware, Maryland, Kentucky, and Missouri stayed in the Union. But the western counties of Virginia seceded from the South later in the war, and formed the state of West Virginia. And secessionist groups set up separate state governments in both Kentucky and Missouri, even though these states stayed in the Union. These groups also sent delegates to the Confederate Congress. This accounts for the 13 stars in the Confederate flag even though only 11 states actually joined the Confederacy.

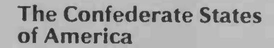
Foreign relations. Britain, France, the Netherlands, Spain, and Brazil were among the countries that recognized the Confederate States as a belligerent, but not as a nation. This meant that Confederate ships received the same privileges granted to vessels of the United States in foreign ports or on the high seas.

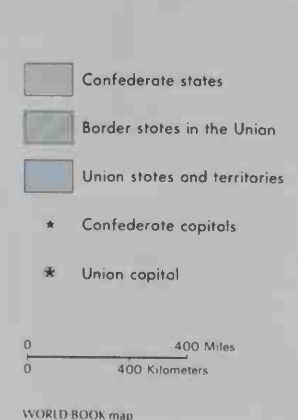
The Confederacy suffered great financial disadvantages. The wealth of the nation, before secession, lay mainly in the North, and the South lacked adequate resources for taxation. The Confederate government had to issue paper money early in the war. This money soon became almost valueless. The people of the Confederate States gave generously to their government and willingly bought government bonds. But their loyal financial support could not create resources that did not exist within the boundaries of the Confederacy.

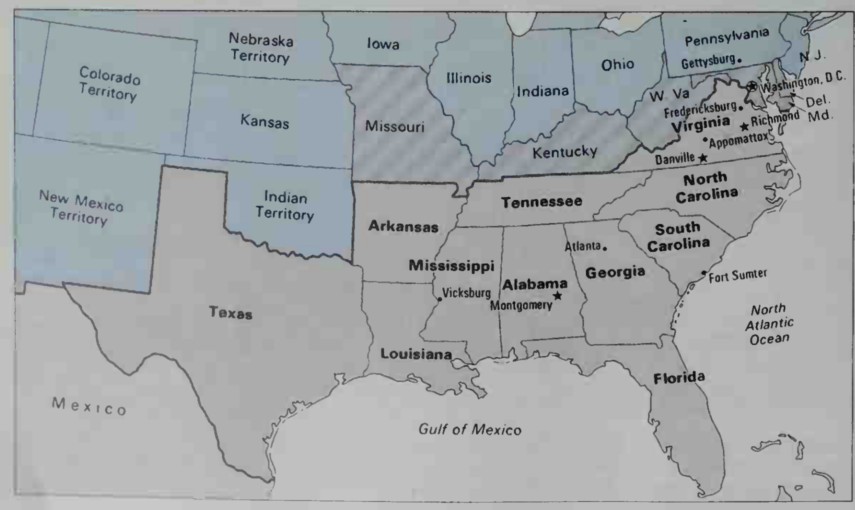
Progress of the war favored the Confederacy in the first months. The defeat of the Union forces at Fredericksburg, in December 1862, led the emperor of France, Napoleon III, to offer his services as peacemaker between the Union and the Confederacy. The Union rejected this offer.

In 1863, the tide began to turn against the Confederacy. The Union armies could get more materials and supplies from the industrial North than the Confederate armies could obtain from the agricultural South. The North kept its army supplied with ammunition, food, and clothing, while the army of the South often lacked these supplies. Union ships blockaded Southern ports. The only way the South could bring in necessary supplies from overseas was to run the blockade. But Southern soldiers fought bravely until there was no longer any hope of victory.

The Confederate Congress met often during the war, mainly to follow the bidding of President Davis, who freely used his war powers. Union forces took Richmond on April 3, 1865. Danville, Va., then became the capital of the Davis government. The main Confederate army, the Army of Northern Virginia, surrendered on April 9, 1865. The people of the Confederacy had defended a way of living that to them seemed right. But


The Confederate States of America





they yielded to superior force. The road to reunion in spirit between the North and the South was long, but by the beginning of the 1900's resentment had been largely forgotten. Thomas L. Connelly

Related articles. See the *History* section of the articles on the states of the Confederacy. See also:

Benjamin, Judah P.
Breckinridge, John C.
Civil War
Davis, Jefferson
Emancipation Proclamation
Flag (picture: Flags in United States history)
Fort Sumter
Johnston, Joseph Eggleston
Lee, Robert E.
Mallory, Stephen R.
Nullification
Seddon, James A.
Semmes, Raphael
States' rights
Stephens, Alexander H.
Walker, Leroy P.

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Confederation, Articles of. See Articles of Confederation.

Confederation Congress. See Congress of the Confederation.

Confederation of Canada was the union of British colonies that formed the Dominion of Canada in 1867. The dominion was established by the British Parliament under terms of the British North America Act. At first, it consisted of four provinces—New Brunswick, Nova Scotia, Ontario, and Quebec. It expanded across North America and developed into present-day Canada.

Early colonies of Canada. After the Revolutionary War in America ended in 1783, Britain still had four colonies in North America. These colonies, which spread across what is now eastern Canada, were Newfoundland, Nova Scotia, St. John's Island, and Quebec. New Brunswick was established in 1784, and St. John's Island was renamed Prince Edward Island in 1799.

Most of the people outside of Quebec were of English descent. The majority of them had come directly to Canada from England. Others were people loyal to the British government who had left the United States after the Revolutionary War in America. In Quebec, however, most of the people were of French descent. Quebec had been a French colony from 1608 until 1763, when Britain acquired it as a result of its victory in the French and Indian War.

In 1791, Britain divided Quebec into the colonies of Upper Canada and Lower Canada. Upper Canada occupied the region along the Great Lakes and the upper part of the St. Lawrence River. Most of its people were of British descent. Lower Canada lay to the northeast of Upper Canada and consisted primarily of French Canadians.

In 1837, minor rebellions broke out in both Upper and Lower Canada. The leaders of the revolts, William Lyon Mackenzie in Upper Canada and Louis Joseph Papineau in Lower Canada, both sought more authority over local affairs for their colonial legislatures. Conflicts between the French-speaking majority and the English-speaking minority contributed to the revolt in Lower Canada. Neither rebellion gained broad support, and British troops easily put them down. However, the events moved the British government to send a representative to examine the causes of the rebellions. The representative, the Earl of Durham, arrived in Canada in 1838. See **Rebellions of 1837**.

Lord Durham's Report was submitted in 1839. It took the position that the Canadian colonies would wish to remain in the British Empire if Britain allowed them to govern their local affairs. Lord Durham also recommended the eventual union of all the Canadian colonies under a central government. As a step toward this goal, he suggested combining Upper and Lower Canada. These proposals had been suggested earlier, and the British Parliament largely disregarded his report.

In 1840, however, Parliament passed the Act of Union. This act, which took effect in 1841, joined Upper and Lower Canada into a new colony called the Province of Canada. In 1848, Britain allowed a new form of government, called *responsible government,* in the Province of Canada. Under this system, an elected Legislative Assembly—rather than the British government's representatives in the colony—had the chief authority over local affairs. By 1855, similar governments had been set up in nearly all the Canadian colonies.

Continuing problems. During the 1850's, the political balance between the English- and French-speaking groups in the Province of Canada broke down. The colony's Legislative Assembly consisted of an equal number of members from each of the former colonies of Upper Canada and Lower Canada. But the united colony had more English-speaking than French-speaking people, and the English began to resent the equal political strength of the French minority. Because the two groups were almost evenly represented, it became more and more difficult for a government formed by either group to win broad support and stay in power.

Other conflicts arose because some people in the colony wanted to expand westward into the vast areas north and west of the Great Lakes. The British government had entrusted these areas to the Hudson's Bay Company, a large English fur-trading firm. Still other people pushed for construction of a railroad to link the Province of Canada with the Atlantic Coast colonies. Also, by the 1860's, all the Canadian colonies had become worried about military defense. The Civil War had begun in the United States in 1861, and many Canadians feared an invasion by American forces if Britain openly supported the rebelling Southern States. In addition, the colonies feared U.S. expansion into the territory north and west of the Great Lakes.

Moves toward confederation. During the mid-1860's, a group of political leaders in the Province of Canada finally decided that a strong union of all the colonies offered the best solution to their problems. The leaders of this group were John A. Macdonald, a conservative from the old area of Upper Canada; George Étienne Cartier, a conservative from Lower Canada; and George Brown, a liberal journalist and member of the colonial assembly. In September 1864, they met with political leaders from New Brunswick, Nova Scotia, and Prince Edward Island in Charlottetown, P. E. I. At this meeting, called the *Charlottetown Conference,* the dele-

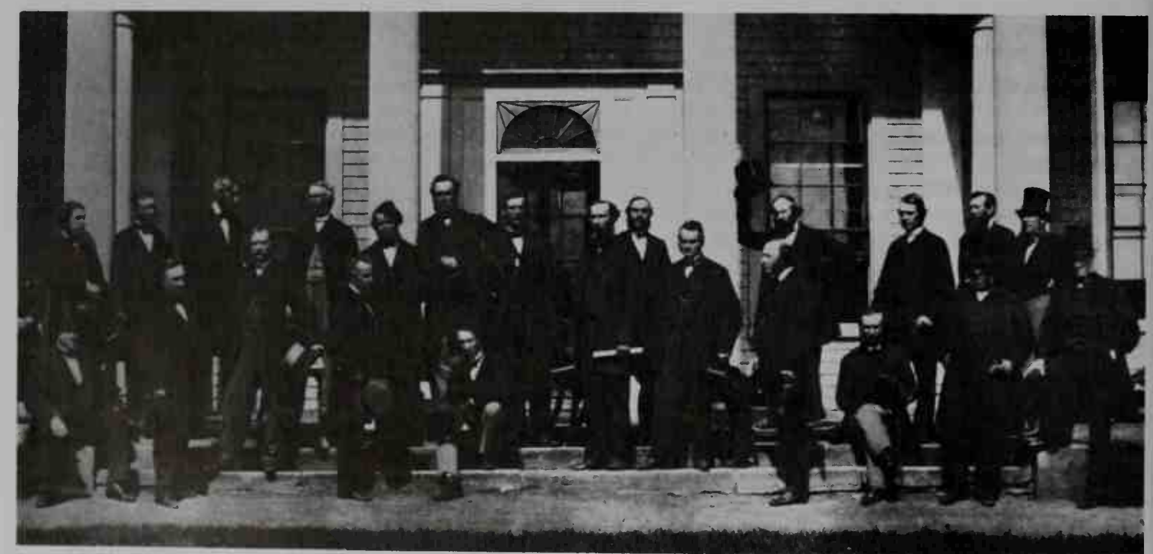
gates from the Province of Canada convinced the leaders of the other colonies that a confederation of the North American colonies should be created.

The details of the confederation were worked out the following month in Quebec City. This meeting, which included representatives from Newfoundland, became known as the *Quebec Conference.* The *Fathers of Confederation,* as the delegates to Charlottetown and Quebec came to be called, planned a new nation. They outlined their plan in 72 points called the *Quebec Resolutions.* The new nation would have two levels of government—provincial and national—and, like the United States, would be a federation. But it would follow the British system of parliamentary government. It would be a self-governing community within the British Empire, not an independent country. The plan also called for the creation of a province that the French-speaking Canadians would control. See **Quebec Conference.**

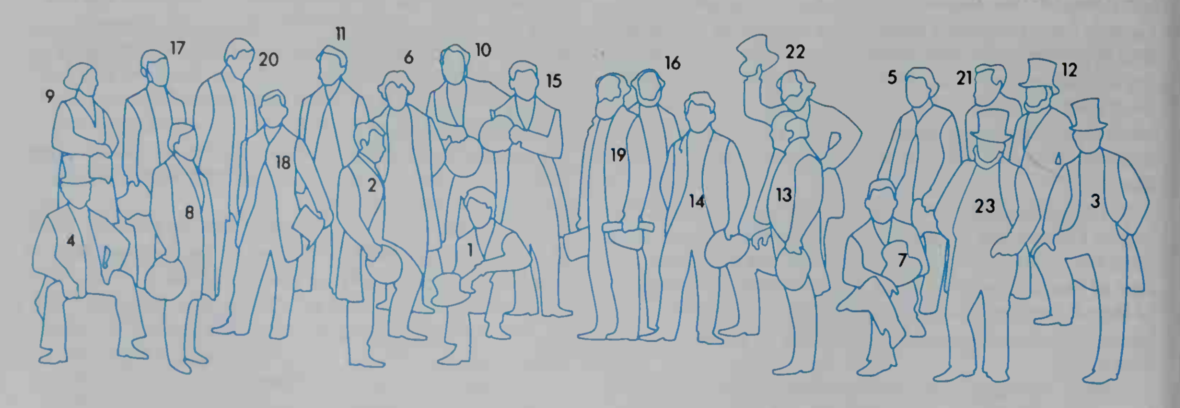
The plan for confederation did not easily win acceptance. Many people in the Atlantic Coast colonies were satisfied with their existing status. They feared they would lose control over their affairs in any union with the larger Province of Canada. Voters in New Brunswick and Prince Edward Island rejected confederation. Strong opposition blocked the plan in Newfoundland and Nova Scotia. The Province of Canada approved confederation. But many French Canadians there worried that their rights might be diminished in the new nation.

Approval of confederation. Resistance to the plan weakened as it became clear that Britain strongly favored the union. The British government hoped it would cost less to defend and assist a united colony than it would a group of separate colonies. The plan for confederation attracted additional support in 1865, when the United States decided to end an agreement that had helped increase trade with the British colonies. The col-

Fathers of Confederation



Public Archives of Canada, Ottawa



WORLD BOOK illustration by Bill and Judie Anderson

Plans for confederation began to take shape at a meeting of Canadian leaders in Charlottetown, P.E.I., in September 1864. The Charlottetown delegates, *above,* may be identified by comparing the numbers on the illustration with those in the table on the next page.

onies then realized they would have to cooperate, either to get a new trade agreement with the United States or to stimulate trade among themselves.

Confederation became even more appealing when the Fenian Brotherhood began to launch attacks on Canada in April 1866. The brotherhood, an organization of Irish-Americans, planned to capture Canada and hold it until Britain agreed to free Ireland. American and Canadian forces stopped the Fenian raiders, but the attacks persuaded many people in the colonies that a united Canada offered them the most effective defense.

During the height of the Fenian scare, the Nova Scotia legislature approved confederation. New Brunswick voters defeated the anticonfederation government in the colonial elections of June 1866. Samuel L. Tilley, the new premier, quickly succeeded in getting the legislature to approve the proposal for union.

Later in 1866, leaders of the Province of Canada, New Brunswick, and Nova Scotia met in London to prepare the final details. They adopted the Quebec Resolutions with only minor changes. The British Parliament readily approved the necessary legislation in March 1867. The legislation, which consisted chiefly of the Quebec Resolutions, was called the British North America Act. It provided for the formation of the Dominion of Canada and served as the new dominion's constitution.

The British North America Act took effect on July 1, 1867. The dominion it created consisted of four provinces—New Brunswick, Nova Scotia, Ontario, and Quebec. Ontario and Quebec had been formed by dividing the Province of Canada. The British North America Act also provided that other provinces could be added to the Dominion of Canada. The dominion's population totaled about $3\frac{1}{2}$ million. John A. Macdonald, one of the leading confederation supporters in the Province of Canada, became the first prime minister of the newly

Fathers of Confederation

Name	Position	Life dates	Occupation
Canada			
* **Sir Étienne-Paschal Taché** (Conservative)	Prime Minister, Chairman of the Quebec Conference	1795-1865	Doctor
1. **John Alexander Macdonald** (Conservative)	Attorney General for Upper Canada	1815-1891	Lawyer
2. **George Étienne Cartier** (Conservative)	Attorney General for Lower Canada	1814-1873	Lawyer
3. **George Brown** (Reform)	President of the Executive Council	1818-1880	Journalist
* **Oliver Mowat** (Reform)	Postmaster General	1820-1903	Lawyer
4. **Alexander Tilloch Galt** (Independent Conservative)	Minister of Finance	1817-1893	Financier
5. **William McDougall** (Reform)	Provincial Secretary	1822-1905	Lawyer
6. **Thomas D'Arcy McGee** (Reform, then Conservative)	Minister of Agriculture	1825-1868	Journalist
7. **Alexander Campbell** (Conservative)	Commissioner of Crown Lands	1822-1892	Lawyer
* **Jean-Charles Chapais** (Conservative)	Commissioner of Public Works	1811-1885	Merchant
8. **Hector-Louis Langevin** (Conservative)	Solicitor General for Lower Canada	1826-1906	Lawyer
* **James Cockburn** (Conservative)	Solicitor General for Upper Canada	1819-1883	Lawyer
Nova Scotia			
9. **Charles Tupper** (Conservative)	Premier and Provincial Secretary	1821-1915	Doctor
10. **William Alexander Henry** (Conservative)	Attorney General	1816-1888	Lawyer
11. **Robert Barry Dickey** (Independent Conservative)	Member of the Legislative Council	1811-1903	Lawyer
12. **Jonathan McCully** (Liberal)	Member of the Legislative Council	1809-1877	Editor
13. **Adams George Archibald** (Liberal)	Leader of the Opposition	1814-1892	Lawyer
New Brunswick			
14. **Samuel Leonard Tilley** (Liberal)	Premier and Provincial Secretary	1818-1896	Druggist
15. **William Henry Steeves** (Liberal)	Delegate without Portfolio	1814-1873	Politician
16. **John Mercer Johnson** (Liberal)	Attorney General	1818-1868	Lawyer
* **Peter Mitchell** (Independent Liberal)	Member of the Legislative Council	1824-1899	Lawyer
17. **Edward Barron Chandler** (Conservative)	Member of the Legislative Council	1800-1880	Lawyer
18. **John Hamilton Gray** (Conservative)	Leader of the Opposition	1814-1889	Lawyer
* **Charles Fisher** (Liberal)	Member of the Legislative Assembly	1808-1880	Lawyer
Newfoundland			
* **Frederic Bowker Terrington Carter** (Conservative)	Speaker of the Legislative Assembly	1819-1900	Lawyer
* **Ambrose Shea** (Liberal)	Leader of the Opposition	1815-1905	Merchant
Prince Edward Island			
19. **Colonel John Hamilton Gray** (Conservative)	Premier, Chairman of the Charlottetown Conference	1812-1887	Army officer
20. **Edward Palmer** (Conservative)	Attorney General	1809-1889	Lawyer
21. **William Henry Pope** (Conservative)	Provincial Secretary	1825-1879	Lawyer
22. **Andrew Archibald Macdonald** (Liberal)	Member of the Legislative Council	1829-1912	Merchant
23. **George Coles** (Liberal)	Member of the Legislative Assembly	1810-1875	Brewer, distiller
* **Thomas Heath Haviland** (Conservative)	Member of the Legislative Assembly	1822-1895	Lawyer
* **Edward Whelan** (Liberal)	Member of the Legislative Assembly	1824-1867	Journalist

* Members who attended only the Quebec Conference

formed nation. See Macdonald, Sir John Alexander.

Confederation set the stage for the development of a great country. Through the years, other provinces joined the Dominion of Canada. In 1931, Canada formally became an independent nation. Michael Bliss

See also British North America Act; Canada, History of (The struggle for responsible government; map); Hudson's Bay Company

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Conference on Security and Cooperation in Europe. See Organization for Security and Cooperation in Europe.

Confession, in religion. See Eastern Orthodox Churches (Sacraments); Roman Catholic Church (Penance).

Confession, in law, is a voluntary statement in which a person admits being guilty of a crime and describes how the crime occurred. Confessions are considered a part of criminal law, which involves actions that are harmful to society.

In the United States, courts classify confessions into two basic groups. *Judicial confessions* are made during court proceedings. *Extrajudicial confessions* are made outside of court to officers of the law or to people who are not officials. Judges do not allow involuntary confessions to serve as evidence or proof in court. These confessions are obtained improperly by such methods as injuring, threatening, or making promises to a suspect.

In 1966, in the case of *Miranda v. Arizona,* the Supreme Court of the United States established the chief safeguards for the rights of suspects. The court ruled that before police officers question a person who is being held in custody, they must inform that person of certain rights. For example, the person has the right to remain silent and to have a lawyer present when being questioned by the police. If the police do not observe a suspect's rights, the court will not accept as evidence the statements that the suspect made to them.

In cases involving civil law, rather than criminal law, statements made by a party to a lawsuit are called *admissions* if the statements are against the party's own interest. Civil law covers such matters as contracts, personal injuries, and property ownership. Admissions may serve as evidence. Paul C. Giannelli

See also Escobedo v. Illinois; Miranda v. Arizona.

Confirmation is a religious ceremony practiced by several faiths. In the Roman Catholic, Eastern Orthodox, and Lutheran churches, and in the Church of England, it is associated with baptism. Roman Catholics believe that it confers the grace of the Holy Spirit on baptized people. In Protestant churches, the baptized renew or affirm the promises made for them at baptism. In Judaism, boys are confirmed at the age of 13 in a ceremony called *bar mitzvah.* Some temples have similar ceremonies for girls called *bat mitzvah.* See also Baptism; Bar mitzvah; Bat mitzvah. Frank C. Senn

Conflict of interest occurs if an individual has a financial or other interest in a company doing business with his or her employer. For example, a person working for a government agency that awards contracts to private industry may have a financial interest in a company bidding for these contracts. A conflict of interest occurs if the government employee favors the company in which he or she has an interest. The conflict-of-interest issue often arises when business executives take positions in government. Full-time government employees must give up all outside financial interests that might conflict with their duties. In 1977, Congress enacted a strict code of ethics, which included provisions to discourage conflicts of interest. Charles O. Jones

Confucianism is a philosophy based on the ideas of the Chinese philosopher Confucius. It originated about 500 B.C. From the 100's B.C. to the A.D. 1900's, Confucianism was the most important single force in Chinese life. It influenced Chinese education, government, and personal behavior and the individual's duty to society.

Many people consider Confucianism a religion. But Confucianism has no clergy and does not teach the worship of a God or gods or the existence of a life after death. Confucianism can more accurately be considered a guide to morality and good government.

Early Confucianism. Confucius was born about 551 B.C. At that time, constant warfare raged among the many states that made up China. Rapid political change altered the structure of Chinese society, and large numbers of people no longer respected the established standards of social behavior. Confucius feared that this threat to orderly social life would lead to the destruction of civilization.

Confucius believed his society could be saved if it emphasized sincerity in personal and public conduct. The key to orderly social life was the gentleman. Confucius defined a gentleman not as a person of noble birth, but as one of good moral character. A gentleman was truly reverent in worship and sincerely respected his father and his ruler. He was expected to think for himself, guided by definite rules of conduct. Confucius included many of these rules in sayings. For example, Confucius taught a version of the golden rule—"What you do not wish for yourself, do not do to others" (see Golden rule). A gentleman also studied constantly and practiced self-examination. He took, as Confucius said, "as much trouble to discover what was right as lesser men take to discover what will pay."

Confucius believed that when gentlemen were rulers, their moral example would inspire those beneath them to lead good lives. Virtuous behavior by rulers, he declared, had a greater effect in governing than did laws and codes of punishment.

When Confucius died about 479 B.C., he was largely unknown. His followers spread his ideas. The most important early Confucian philosophers were Mencius (390?-305? B.C.) and Xunzi (mid-200's B.C.). Mencius believed people were born good. He stressed the need to preserve "the natural compassion of the heart" that makes people human. Mencius emphasized the past as an ideal age and a model for examining present problems. In contrast, Xunzi believed people could be good and live together peacefully only if their minds were shaped by education and clear rules of conduct.

By about 200 B.C., the first large, unified Chinese empire had begun. The rulers approved of Confucianism's emphasis on public service and respect for authority. In 124 B.C., the government established the Imperial University to educate future government officials in Confucian ideals. The university based its teachings on five books of Confucian thought called the *Five Classics.* Mastery of the *Classics* became proof of moral fitness and the chief sign of a gentleman.

Later Confucianism. The early Confucianists concerned themselves primarily with the needs of society. However, ideas from Taoism and other philosophies helped shift the emphasis to additional areas of human experience. For example, a person's ability to live in harmony with nature was a minor issue to Confucius. But it became an important theme in Confucian thought during the 200's and 100's B.C.

From about A.D. 200 to 600, interest in Confucianism declined in China. Many Chinese turned instead to Buddhism and Taoism. These religions dealt with problems that the teachings of Confucianism largely ignored, such as the meaning of suffering and death.

A revival of interest in Confucius' philosophy began in the 600's. By the 700's, candidates for government jobs had to take a civil service examination based on Confucian ideas. The examination carried out Confucius' belief that an enduring state must be built on the merit of its rulers' advisers.

Zhu Xi (1130-1200) became a leader of a movement called *Neo-Confucianism.* Zhu developed a branch of Neo-Confucianism called the *rational wing.* It emphasized study and investigation of *Li,* the pattern behind human and natural relationships. Scholars led by Wang Yangming (1472-1529) developed the *intuitional wing* of Neo-Confucianism. They sought enlightenment by a combination of meditation and moral action.

Confucianism continued to actively influence Chinese life until it came into conflict with European ideas, especially Communism, in the 1900's. For many years, the Chinese Communist government opposed Confucianism because the philosophy encouraged people to look to the past rather than to the future. However, official opposition ended in 1977. N. Sivin

See also **Confucius; I Ching; Mencius; Religion** (Confucianism; picture: Confucius' birthday); **Xunzi**

Additional resources

Berthrong, John H. *Transformations of the Confucian Way.* Westview, 1998.
Cleary, Thomas. *The Essential Confucius.* 1992. Reprint. Castle Bks., 1998.

Confucius, *kuhn FYOO shuhs* (551?-479? B.C.), was the most influential and respected philosopher in Chinese history. From about 100 B.C. to the revolution of 1911, the ideas of Confucius served as the single strongest influence on Chinese society. These ideas, which are called *Confucianism,* stress the need to develop moral character and responsibility.

Chinese governments made Confucius' teachings the official state philosophy. Millions of people in China—and in such nearby countries as Japan, Korea, and Vietnam—honored Confucius in much the same way as other peoples honor founders of religions. For details of the philosophy of Confucius, see Confucianism.

Confucius was born in the duchy of Lu, in what is now Shandong Province, China. His real name was Kong Qiu. The name *Confucius* is a Latin form of the title *Kongfuzi,* which means *Great Master Kong.* Confucius' parents died when he was a child. He failed in an attempt to become an adviser to a wise ruler. Confucius had wanted the position so he could put into practice his ideas for reforming society. Confucius received some minor official appointments, but at his death he was largely unknown in China. His disciples spread his teachings.

No book definitely written by Confucius exists. His disciples recorded his conversations and sayings in a book called *The Analects.* N. Sivin

See also **Religion** (picture: Confucius' birthday).

Conga drum is a percussion instrument chiefly used in Latin American music. Jazz bands and combos sometimes use it as a rhythm instrument.

A conga drum is shaped like a slightly rounded cylinder and is made of wood or fiberglass. An animal skin covering called a *head* is stretched across the top of the cylinder. Musicians strike the head with the fingers and the entire surface of the hand. Drumsticks are not used. Most musicians play a conga drum while sitting, with the drum held between the knees. Some drummers may also play the drum while standing, with the instru-



© Peter Gonzalez

The conga drum is popular in Latin American music. Musicians strike the drum with their fingers and hands. They usually play sitting down, holding one or two drums.

ment mounted on a stand or suspended by a strap from the shoulder. There are three types of conga drum. They are, from highest to lowest pitch, the quinto, the conga, and the tumbadora.

The conga drum developed from an ancient African drum. This drum consisted of a section of a hollow tree trunk with an animal skin stretched across one end.

John H. Beck

Congenital defect. See **Birth defect.**

Conglomerate. See **Rock** (Clastic sediments; picture).

Conglomerate, in business, is a large corporation that controls or owns a number of companies that generally operate in unrelated markets. A corporation becomes a conglomerate through various types of *mergers* (combinations of two or more companies). Conglomerates tend to maintain the separate identity and management of their different companies.

There are three types of conglomerate mergers: (1) market extension mergers, (2) product extension mergers, and (3) pure conglomerate mergers. Market extension mergers combine companies that sell similar products or services in separate geographic markets, such as an international air carrier acquiring a regional airline. Product extension mergers bring together firms in related markets, such as an air carrier buying a bus company that serves several states. Pure conglomerate mergers combine firms in unrelated markets, such as an air carrier purchasing a fast-food chain.

During the late 1900's, conglomerates made up three-fourths of all business mergers. Corporations often form conglomerates to avoid a disastrous loss. A conglomerate can usually offset temporary losses in some of its companies with the gains of others. Conglomerates also may obtain some savings by joining or coordinating production, marketing, financial, and management activities. Critics claim some conglomerates hurt competition by obtaining a strong position in a market without adding to the number of firms in that market. Critics fear that the financial power of some conglomerates can help them dominate markets previously composed of many small, single-industry firms.

However, supporters of conglomerates have argued that the financial power of a conglomerate does not guarantee it can control any market in which the firm sells. Supporters have also argued that conglomerates maintain competition by restoring some weak companies that otherwise might go bankrupt. Robert B. Carson

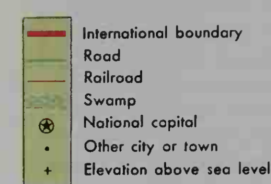
Congo (Brazzaville) is a hot, humid country in west-central Africa. The equator runs through the country. Thick forests of trees and tangled bushes and vines cover the northern half of Congo. Much of this part of the country is inhabited chiefly by wild animals. The few people who live there travel by dugout canoe.

Congo was once a territory in French Equatorial Africa. It became independent in 1960. Its name in French, the official language, is République du Congo (Republic of the Congo). It is called Congo (Brazzaville) to distinguish it from its neighbor, Congo (Kinshasa). Brazzaville is the capital and largest city.

Most of Congo's soil is poor, but the country has several mineral resources. Congo is a transportation center. Pointe-Noire, on the Atlantic coast, is an important port.

Government. In 1997, rebels led by former dictator General Denis Sassou-Nguesso overthrew the elected

Congo (Brazzaville)







WORLD BOOK maps

government of Congo. Sassou-Nguesso declared himself president and set up a transitional government. In January 2002, voters approved a new constitution for the country. The constitution calls for a president, to be elected for a seven-year term, and for a Parliament consisting of a 137-member national assembly and a 60-seat senate. In March 2002, voters elected Sassou-Nguesso

Facts in brief

Capital: Brazzaville.

Official language: French.

Area: 132,047 mi² (342,000 km²). *Greatest distances*—north-south, 590 mi (950 km); east-west, 515 mi (829 km). *Coastline*—100 mi (160 km).

Population: *Estimated 2002 population*—3,105,000; density, 24 per mi² (9 per km²); distribution, 59 percent rural, 41 percent urban. *1984 census*—1,843,421.

Chief products: *Agriculture*—bananas, cassava, coffee, palm kernels and oil, peanuts, plantains, rice, rubber, sugar cane, sweet potatoes, yams. *Forestry*—limba, mahogany, okoumé. *Mining*—lead, natural gas, petroleum, potash, zinc.

Flag: A large green triangle is in the upper left corner, and a large red triangle is in the lower right corner. The triangles are separated by a yellow diagonal stripe. Adopted in 1991. See **Flag** (picture: Flags of Africa).

Money: *Basic unit*—franc.



Shostal

Brazzaville is the capital, largest city, and commercial center of the Republic of the Congo. The city lies on the Congo River.

president under the new constitution.

People. Most of Congo's people live either on the southern border near Brazzaville or on the coast in and around Pointe-Noire. The people belong to four main groups: (1) the Kongo, (2) the Batéké, (3) the M'Bochi, and (4) the Sangha. Each group includes several subgroups. About 45 percent of the people belong to the Kongo group, farmers who live west and southwest of Brazzaville. About 20 percent are Batéké. They live north of Brazzaville and hunt and fish for a living. About 10 percent are M'Bochi. Fishing was once the chief means of support for the M'Bochi. Today, many work as clerks and technicians. The Sangha live in the northern forests.

About half the people practice *fetish* religions. They believe that all things have spirits. About 4,500 people are Muslims, and most of the rest are Christians.

Most of the older Congolese cannot read or write, but about 75 percent of the children now receive some elementary education. The Center of Administrative and Advanced Technical Studies in Brazzaville offers higher education to Congolese and to students from the Central African Republic, Chad, and Gabon.

Land. Congo covers 132,047 square miles (342,000 square kilometers). It includes six geographical regions.

The Coastal Plain extends about 40 miles (64 kilometers) inland from the Atlantic Ocean. The region is generally dry and treeless. Lagoons are near the coast.

The Mayombé Escarpment, and a series of plateaus rising from 1,600 to 2,600 feet (490 to 790 meters) above sea level, lie inland, behind the coastal plain. River valleys are cut into these forested ridges.

The Niari Valley, a richer farming region, lies beyond the Mayombé Escarpment. It is covered by wooded land and *savannas* (grasslands with scattered trees).

The Stanley Pool Region, east of the Niari Valley, consists of a series of bare hills. Most of the land there has been cleared for farming. Stanley Pool is a lake formed by the widening of the Congo River.

The Batéké Plateau is a grass-covered elevated plain in central Congo. Deep, forested valleys containing tributaries of the Congo River divide the plateau.

The Congo River Basin in the north includes large swampy areas. The Ubangi, the main Congo tributary, forms the country's northeastern border.

Most of Congo is hot and humid, with rainfall throughout the year. Parts of the Congo River Basin receive about 100 inches (250 centimeters) of rainfall a year, and temperatures average from 75 to 78 °F (24 to 26 °C). The Batéké Plateau averages less than 60 inches (150 centimeters) of rain a year. Temperatures there vary from 70 to 80 °F (21 to 27 °C). The coastal area is cooler and drier than the rest of the country.

Economy. Except for its forests and some minerals, Congo has few natural resources. The country also has few industries and a high rate of unemployment.

Most of the Congolese raise bananas, corn, rice, and other crops to feed their own families. Petroleum is the country's most valuable resource. Congo's mineral resources include lead, potash, and zinc. Lumber and petroleum are the chief exports.

Congo has one of the longest transportation systems in Africa. The Congo-Ocean railroad, a 320-mile (515-kilometer) line linking Brazzaville and Pointe-Noire, and its branch line form the only railroad. Barges use the Congo and Ubangi rivers north of Stanley Pool at Brazzaville, but rapids below Stanley Pool prevent barges from getting to or from the ocean. The Congo-Ubangi river system carries goods and passengers as far as Bangui, capital of the Central African Republic, a distance of 700 miles (1,100 kilometers). Most of the exports and imports of the Central African Republic and Chad move over the river system and the Congo-Ocean railroad. Gabon's manganese ore moves over the branch of the railroad. This shipping trade is important to the Congo economy. Building and maintaining roads is difficult because of heavy rains and thick forests.

History. A small part of what is now Congo probably was part of the Kongo kingdom, which flourished during the 1400's and 1500's (see **Kongo**). Portuguese explorers reached the Congo coast in the 1400's. Portuguese and other European traders bought slaves and ivory along the coast from the late 1400's to the 1800's. But Europeans did not explore the interior of what is now Congo until the late 1800's. Pierre Savorgnan de Brazza, a French explorer, reached the area in 1875. Henry M. Stanley, the famed British explorer, sailed down the Congo River from its source to the ocean in 1876 and 1877 (see **Stanley and Livingstone**).

In 1880, Brazza and Makoko, the Batéké king, signed a treaty that placed the area north of the Congo River under French protection. This area, then called Middle Congo, became a territory in French Equatorial Africa in 1903. In 1910, it was linked with the territories of Gabon, Chad, and Ubangi-Shari (now the Central African Republic). Middle Congo gained internal self-government in 1958. It became independent on Aug. 15, 1960.

In 1969, a group of army officers seized power in a military coup. They declared Congo a Marxist state and renamed it the People's Republic of the Congo. From 1970 to 1991, a series of military rulers held power. The government took control of industries. A Marxist group called the Congolese Labor Party was the only political party, and delegates to the National Assembly were elected from a list of candidates approved by the party.

During the 1980's, economic problems and rivalries between Congo's ethnic groups brought growing pressure for political reform. In 1989, the government began to reduce state ownership of industries. In 1990, the government abandoned Marxism as its official philosophy and agreed to permit the formation of opposition political parties. In 1992, voters gave overwhelming approval to a new constitution that called for a multiparty system and direct election of the president. The country resumed its former name, Republic of the Congo.

The first multiparty presidential election took place in 1992. Pascal Lissouba was elected president. In June 1997, a civil war broke out between Lissouba's government forces and rebels loyal to former dictator General Denis Sassou-Nguesso. The fighting lasted until October, when Sassou-Nguesso's forces overthrew the Lissouba government. Sassou-Nguesso declared himself president. In 2002, voters approved a new constitution calling for an elected president and a two-house Parliament. Later that year, Sassou-Nguesso was elected president under the new constitution, and his party won control of both houses of Parliament. Samuel Decalo

See also **Brazzaville; Congo River**.

Congo (Kinshasa) is a large country in the heart of Africa. A narrow strip of Congo borders the Atlantic Ocean. But most of the country lies deep in the interior of Africa. The equator runs through northern Congo.

One of the world's largest and thickest tropical rain forests covers about a third of Congo. The Congo River flows through the forest and is a chief means of transportation. Many kinds of wild animals live in Congo.

Most of Congo's people are farmers and live in small rural villages. But each year, many villagers move to the cities. Kinshasa is Congo's capital and largest city.

Belgians ruled Congo from 1885 until it became an independent nation in 1960. The nation was known as Zaire from 1971 to 1997. That year, rebels seized power and restored the name Congo. The country is called Congo (Kinshasa) to distinguish it from neighboring Congo (Brazzaville). Its full name in French, the official language, is République Démocratique du Congo (Democratic Republic of the Congo).

Europeans greatly influenced Congo's economic and cultural life up to the time of independence. Congo's people are divided into a large number of different ethnic groups, and the country has faced severe economic problems. These problems have increased since the outbreak of civil war in Congo in 1998.

Facts in brief

Capital: Kinshasa.
Official language: French.
Area: 905,355 mi² (2,344,858 km²). *Greatest distances*—north-south, about 1,300 mi (2,090 km); east-west, about 1,300 mi (2,090 km). *Coastline*—25 mi (40 km).
Elevation: *Highest*—Margherita Peak, 16,762 ft (5,109 m) above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 2002 population*—54,768,000; density, 60 per mi² (23 per km²); distribution, 71 percent rural, 29 percent urban. *1984 census*—29,916,800.
Chief products: *Agriculture and forestry*—bananas, cassava, cocoa, coffee, cotton, corn, palm oil, peanuts, rice, rubber, tea, timber. *Manufacturing*—beer, cement, processed foods, soft drinks, steel, textiles, tires. *Mining*—cadmium, cobalt, copper, gold, industrial diamonds, manganese, oil, silver, tin, zinc.
Money: *Basic unit*—Congolese franc. One hundred centimes equal one Congolese franc.

Government

National government. From 1965 until the early 1990's, President Mobutu Sese Seko ruled the nation as a dictator. In 1997, rebels overthrew Mobutu, and he fled the country. Rebel leader Laurent Kabila declared himself president and formed a transitional government. In 2000, Kabila created a transitional parliament and appointed its members. After Kabila's death in 2001, his son Joseph became president. As president, Joseph Kabila is head of state and head of the government.

Local government. The country is divided into 10 provinces, plus the separate city of Kinshasa, for purposes of local government. A governor and deputy governor chosen by the president administer each province.

Courts. The Supreme Court is the highest court. It hears appeals from lower courts. The president appoints its members. The country also has three other appeals courts and a variety of lower courts.

Armed forces of Congo include about 50,000 members. Military service is voluntary.

People

Ancestry. Most of Congo's people are descendants of people who began moving to the area from other parts of Africa at least 2,000 years ago. At that time, other African peoples, including a Pygmy group called the Babuti, lived in what is now Congo. The Babuti, like other Pygmy groups, are known for their small size. Today, Congo's people belong to many different ethnic groups. At times, conflicts between the groups have flared up. At other times, they have had peaceful relations.

Languages. Most of Congo's ethnic groups have their own local language. About 200 local languages are spoken in the country. Most of these local languages belong to the Bantu language group and are closely related (see **Bantu**). Most Congolese also speak at least one of the country's four national languages—Kikongo, Lingala, Swahili (also known as Kiswahili), and Tshiluba. French is Congo's official language. Government officials often use French in their work, and many of the country's students learn it in school.

Way of life. Most rural Congolese live in villages that range in size from a few dozen to a few hundred people. The vast majority of village families farm a small plot of land. They raise almost all their own food, including cassava, corn, and rice. Some rural people also catch fish. Few families in the countryside can afford farm machinery, and so most use hand tools. As a result, farm production is low, and most farm families are poor.

After 1960, large numbers of Congolese—especially young people—moved from rural areas to cities. These people were attracted to the cities by the opportunity for jobs in business, industry, and government. The

rapid growth of the cities led to such problems as unemployment and crowded living conditions. In addition, many of the people who have jobs earn low wages and find it difficult to support themselves and their families.

During Belgian rule, few Congolese women received more than a few years of education or held a job outside the home. After independence, the government increased educational and job opportunities for women.

Housing. Most rural Congolese live in houses made from mud bricks or dried mud and sticks. The majority of the houses have thatched roofs. The houses of some well-to-do rural families have metal roofs.

In Congo's cities, business managers and merchants—as well as many Europeans—live in attractive bungalows. But many factory and office workers live in crowded areas of small, cheap houses and apartments made from cinder blocks or baked mud bricks.

Clothing. After independence, most Congolese men who held important jobs adopted a kind of national costume. They wore trousers with a matching collarless jacket that buttoned at the neck. No shirt or tie was worn with this costume. Most male workers and farmers wear long or short trousers with a shirt. Congolese women usually wear a long, one-piece dress of cotton cloth or a blouse and long skirt.

Food and drink. Corn, rice, and *manioc meal*—which is made from cassava—are the basic foods of most of the people. Congolese serve these foods mostly as a thick porridge flavored with a spicy sauce. They add fish or meat to the porridge when they can afford to do so. Beer is a popular beverage. The diet of many Congolese lacks important nutrients, especially protein. As a result, many Congolese suffer from malnutrition.

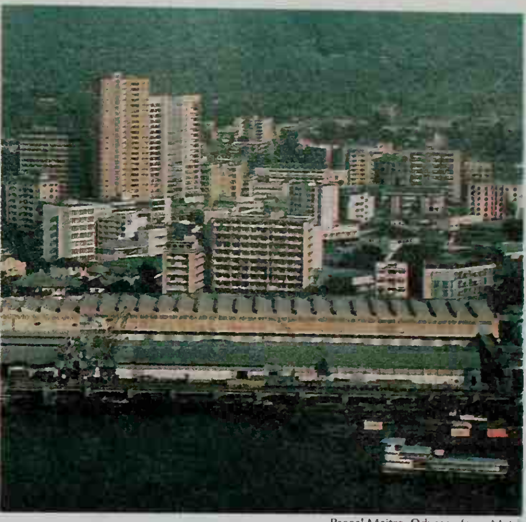
Recreation. Rural Congolese enjoy social gatherings that feature drum music and dancing. Many city people spend much leisure time in barrooms. There, they dance and listen to Congolese jazz provided by recordings or small bands. Soccer ranks as the country's most popular spectator sport.

Religion. More than three-fourths of all Congolese are Christians. Roman Catholics make up the largest Christian group in the country, followed by Protestants and *Kimbanguists.* Kimbanguists are members of an independent Christian church called the Church of Jesus Christ on Earth. Other Congolese are Muslims or practice local African religions.

Education. Children from 6 to 12 years old are required to attend school. But many areas lack enough schools, and this requirement is not strictly enforced. Most parents value education as a key to a better life for their children. Enrollment at elementary schools and secondary schools rose after independence. A secondary school student must pass a nationwide examination to receive a diploma. Schools in Congo's remote rural areas are poorly equipped compared with those in other parts of Congo. Many students from the rural areas fail the diploma exam.

Congo has three major universities, at Kinshasa, Kisangani, and Lubumbashi, and has several other specialized institutes of higher education.

The arts. Carved wooden statues and masks by Congolese artists have been praised by art critics for their delicate form and balance and rich symbolism. Music is also a major art in Congo. The rhythm of drums domi-



Pascal Maitre, Odyssey from Matrix

Kinshasa is the capital and largest city of the Democratic Republic of Congo. It lies on the south bank of the Congo River.



The flag of Congo (Kinshasa), adopted in 1997, returned to the design of the nation's flag from 1960 to 1963.



WORLD BOOK map

Congo (Kinshasa) is a large country that lies near the center of Africa. The equator runs through northern Congo.

nates Congolese music. Urban Congolese have developed their own form of jazz, which blends elements of modern jazz and traditional Congolese music.

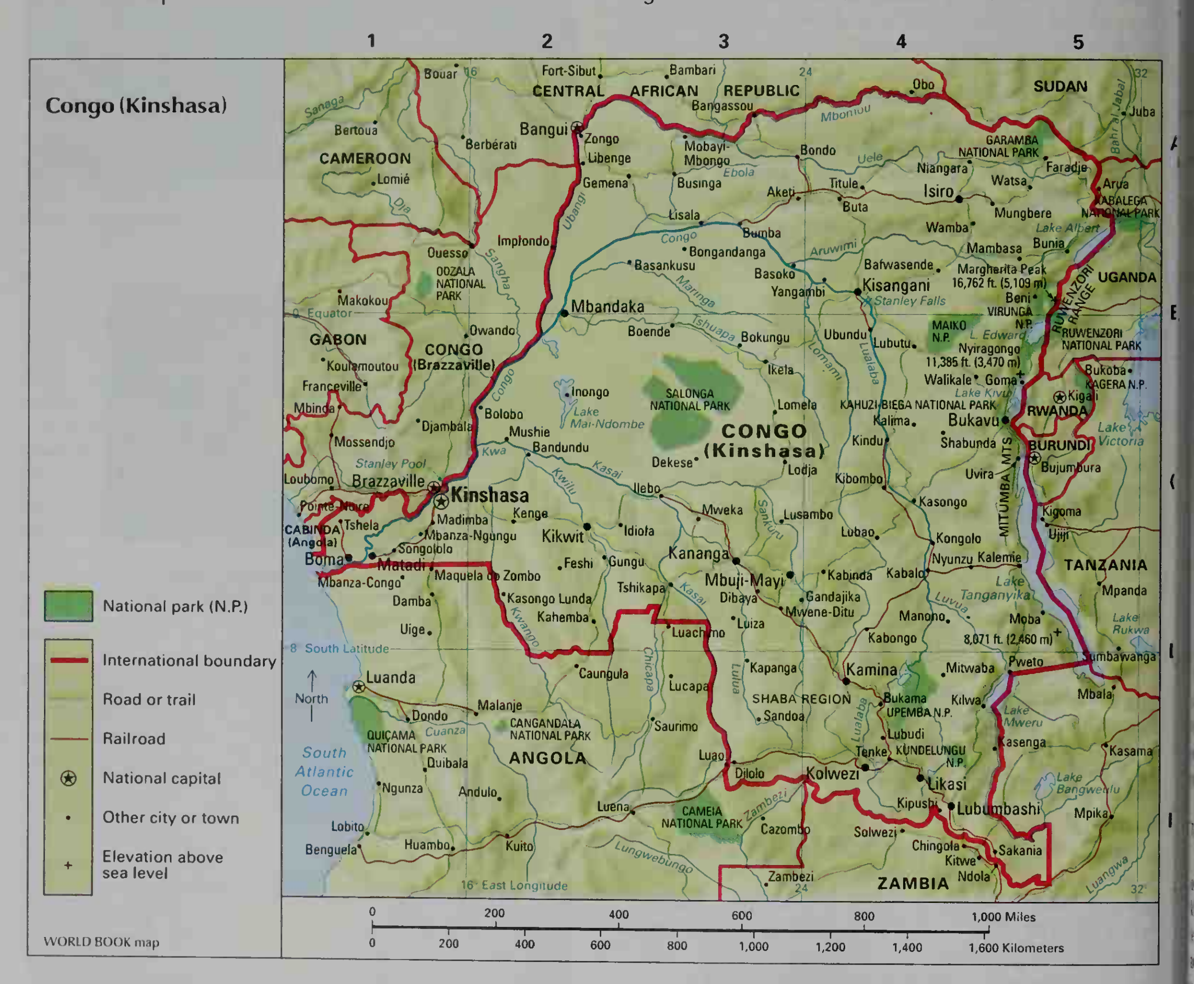
Land and climate

Congo ranks third in area among the countries of Africa. Only Sudan and Algeria are larger than Congo. Congo's land includes three distinct kinds of regions: (1) a tropical rain forest, (2) savannas, and (3) a highland.

The tropical rain forest covers most of the northern part of Congo. It is one of the world's largest and thickest rain forests and has an extraordinary variety of trees and other plants. The forest is so thick that sunlight seldom reaches parts of its floor.

The equator runs through the rain forest, and the area has hot, humid weather all year. Daytime temperatures average about 90 °F (32 °C). Annual rainfall often totals 80 inches (203 centimeters) or more. Much of it falls in heavy thunderstorms.

Savannas. A savanna covers much of southern Congo. Another savanna covers a strip of land north of the rain forest. The savannas are chiefly grasslands, and a variety of grasses grow there. Small groups of trees are scattered throughout the savannas, and forests grow in some valleys. Daytime temperatures in the savannas average about 75 °F (24 °C). The savannas receive little or no rain for several months each year. Annual rainfall averages about 37 inches (94 centimeters).



Cities and towns

City	Population	Map key	
Aketi	22,963	A	3
Bandundu	55,967	C	2
Basankusu	18,039	B	2
Basoko	20,947	B	3
Beni	36,978	B	5
Boende	12,791	B	3
Boma	210,784	D	1
Bondo	11,925	A	3
Bukama	16,493	D	4
Bukavu	158,920	C	5
Bumba	75,156	B	3
Bunia	57,876	B	5
Buta	38,378	A	4
Dibaya	24,916	D	3
Dilolo	8,974	E	3
Faradje	11,086	A	5
Gemena	73,234	A	2
Goma	87,550	B	5
Gungu	12,170	C	2
Idiofa	26,180	C	2
Ikela	8,173	B	3
Ilebo	72,803	C	3
Inongo	18,641	C	2
Isiro	111,193	A	4
Kabalo	25,025	D	4
Kabinda	72,360	D	4
Kahemba	7,135	D	2
Kalemie	65,476	D	5
Kalima	45,156	C	4
Kamina	111,069	D	4
Kananga	460,091	D	3
Kasenga	17,977	E	5
Kasongo	30,339	C	4
Kenge	19,740	C	2
Kikwit	150,677	C	2
Kindu	72,708	C	4
Kinshasa	2,222,981	C	1
Kipushi	38,417	E	4
Kisangani	316,310	B	4
Kolwezi	223,524	E	4
Kongolo	28,550	C	4
Libenge	15,168	A	2
Likasi	208,299	E	4
Lisala	61,396	B	3
Lodja	26,215	C	3
Lomela	6,627	C	3
Lubumbashi	596,297	E	4
Lubutu	6,084	B	4
Luiza	10,156	D	3
Lusambo	16,628	C	3
Manono	51,755	D	4
Matadi	177,357	D	1
Mbandaka	180,298	B	2
Mbanza-Ngungu	54,505	C	1
Mbuji-Mayi	391,845	D	3
Moba	21,217	D	5
Mwene-Ditu	105,549	D	3
Niangara	15,453	A	4
Pweto	13,789	D	5
Sandoa	6,562	D	3
Shabunda	12,755	C	4
Songololo	7,963	C	1
Tshela	20,517	C	1
Tshikapa	107,394	D	3
Ubundu	7,642	B	4
Uvira	76,451	C	5
Wamba	17,461	B	4
Watsa	26,119	A	5
Zongo	21,046	A	2

Source: 1984 official estimates.

Physical features

Feature	Map key	
Aruwimi (river)	B	4
Congo (river)	C	2
Ebola (river)	A	3
Kasai (river)	D	3
Lake Albert	B	5
Lake Edward	B	5
Lake Kivu	C	5
Lake Mai-Ndombe	C	2
Lake Mweru	D	5
Lake Tanganyika	D	5
Lomami (river)	B	4
Lualaba (river)	E	4
Margherita Peak	B	5
Mitumba Mountains	C	5
Nyiragongo (volcano)	B	5
Shaba Region	D	3
Stanley Falls	B	4
Ubangi (river)	B	2



Harrison Forman

Small rural villages dot Congo's countryside. Most of the village families farm a small plot of land for a living. They live in small houses with thatched roofs, like the one shown here.



Christian Vioujard, Gamma/Liaison

Congo's cities are growing at a rapid rate. City people often shop in outdoor marketplaces. The busy marketplace shown here is in Goma, a city in eastern Congo.

The highland is an area of plateaus and mountains along Congo's eastern and southeastern borders. Plant life varies with the elevation. Margherita Peak, the highest point in Congo, rises 16,762 feet (5,109 meters) there. Daytime temperatures average about 70 °F (21 °C). Annual rainfall totals about 48 inches (122 centimeters).

Rivers and lakes. The Congo River is Congo's most important waterway. It rises near the southeast corner of the country. The river flows northward to northern Congo and is called the Lualaba River until it reaches Stanley Falls near the equator. It then flows westward across northern Congo. Finally, it flows southwestward until it empties into the Atlantic Ocean in far western Congo. The Congo River is the world's fifth longest river. It flows for 2,900 miles (4,667 kilometers). The Congo carries more water than any other river except the Amazon. Many other rivers branch out from the Congo. They include the Ubangi and Aruwimi to the north and the Lomami and Kasai to the south.

Several deep lakes lie along Congo's eastern border. The largest is Lake Tanganyika.

Animal life. Congo has a spectacular variety of wild animals. Baboons, chimpanzees, gorillas, and many kinds of monkeys live in areas with trees. Antelope, leopards, lions, rhinoceroses, and zebras roam open areas. Crocodiles and hippopotamuses live in or near water. The okapi, a forest-dwelling animal related to the giraffe, lives nowhere else in the world but Congo. It has become a national symbol of the country. Through the years, European hunters killed many animals in Congo and endangered some species. The government set aside large areas of land as part of a national park system where animals are protected from hunters. Many wild animals also still live outside the parks, especially in thinly populated areas in eastern Congo.

Economy

Congo is a poor country with a developing economy. But it has many valuable resources that give it the potential of becoming a wealthy nation. Mining ranks as Congo's most important economic activity.

Mining. Copper is Congo's most important mineral. A huge copper mine operates in the southeastern part of the country. Congo leads the world in the production of industrial diamonds, its second most important mineral. Congo produces petroleum from deposits off its coast. Other economically valuable minerals include cadmium, cobalt, gold, manganese, silver, tin, and zinc.

Agriculture and forestry. Agriculture in Congo centers around small plots, where families struggle to produce enough food for their own needs. The chief food crops include bananas, cassava, corn, peanuts, and rice. Crops raised for sale include cocoa, coffee, cotton, and tea. The trees of Congo's rain forest yield palm oil, rubber, and timber.

Manufacturing. Congo produces relatively small amounts of manufactured goods. Its chief products include beer, cement, processed foods, soft drinks, steel, textiles, and tires. After independence, manufacturing grew in importance in Congo.

Foreign trade. Copper is Congo's most important export by far. Other exports include cobalt, coffee, industrial diamonds, palm oil, and petroleum. Imports include food, textiles, and manufactured goods. Congo trades chiefly with the nations of Western Europe, especially Belgium.

Transportation and communication. Most roads in Congo are unpaved and many are badly rutted, particularly in rainy seasons. Few Congolese own an automobile. The Congo River plays an important role in Congo's transportation system, especially in the rain forest where there are few good roads. The river and its many branches are navigable for about 7,200 miles (11,500 kilometers) in the country.

Congo's railroads operate mostly in the southeastern part of the country. They link mining areas there with river ports and seaports. Matadi is Congo's chief seaport. Airlines serve Congo's major cities and connect Kin-



Agence Hoa-Qui from Tom Stack & Assoc.

The Congo River is Congo's main waterway and the fifth longest river in the world. The people in the picture above are setting traps in the Congo River to catch fish.

shasa with several countries in Africa and Europe.

Radio is the chief means of communication in Congo. Television broadcasts serve the largest cities, but few people can afford TV sets. A number of daily newspapers are published in Congo.

History

Early days. The Babuti were the first known inhabitants of what is now Congo. They have lived there since prehistoric times. At least 2,000 years ago, people from other parts of Africa moved into the area. In the A.D. 700's, well-developed civilizations grew up in southeastern Congo. In the 1400's—or perhaps earlier—several separate states developed in the savanna south of the rain forest. The largest were the Kongo, Kuba, Luba, and Lunda kingdoms. In the 1600's or 1700's, other kingdoms grew up near the eastern border. They carried on long-distance trade with people on the east and west coasts.

The coming of the Europeans. In 1482, Portuguese sailors began stopping at the mouth of the Congo River. Portugal soon established diplomatic relations with the Kongo kingdom, which then ruled the coastal region. Representatives of the kingdom visited Portugal and the Vatican—the headquarters of the Roman Catholic Church—in the late 1400's. The kingdom soon adopted Roman Catholicism as its religion, and a number of Kongo men became Catholic priests.

In the early 1500's, the Portuguese began enslaving black Africans. They bought many of the slaves from the leaders of the Kongo kingdom. Other Europeans soon began taking part in the slave trade. From the early 1500's to the early 1800's, hundreds of thousands of people were enslaved in the Congo area. Most of them were sent to North or South America.

In 1876, Henry M. Stanley, a British explorer, crossed Congo from east to west. Other explorers crossed the area at about the same time. The explorations gave Europeans and Americans their first detailed information about the interior of what is now Congo.

Belgian rule. In 1878, King Leopold II of Belgium hired Stanley to set up Belgian outposts along the Congo River. Through skillful diplomacy, Leopold persuaded other European leaders to recognize him as the ruler of what is now Congo. The recognition stated that Leopold himself—not the Belgian government—was the ruler. The area became Leopold's personal colony on July 1, 1885, and was named the Congo Free State.

The people of the Congo Free State suffered under Leopold's rule. The king's agents treated the people cruelly. For example, they forced villagers to collect a specified amount of rubber in the wild. If the villagers failed to do so, their hands, fingers, or feet were amputated. Women and children were held hostage until their male relatives could provide the required amount of rubber. Leopold's agents also burned villages and farms. Many Congolese died as a result of the harsh treatment.

Leopold's rule brought many protests, especially from the United Kingdom and the United States. In response, the Belgian government took over control of the Congo Free State from Leopold in 1908. Belgium renamed the colony the Belgian Congo. The Belgian government's rule was often harsh, but the government improved working and living conditions somewhat.

By the 1920's, Belgium was earning great wealth from the Belgian Congo's copper, diamonds, gold, palm oil, and other resources. The worldwide Great Depression of the 1930's crippled the colony's economy as prices and demand for its resources fell sharply. In 1940, Belgium entered World War II on the side of the Allies. During the war, the Belgian Congo provided the Allies with valuable raw materials.

After World War II ended in 1945, the Belgian Congo's economy again developed rapidly as prices for its exports soared. The Belgians made efforts to improve education and medical care for the colony's people. But they refused to give them a voice in the government.

Independence. In the 1950's, many Africans in the Belgian Congo began calling for independence from Belgium. In 1957, Belgium allowed the colony's people to elect their own representatives to some city councils. But the demand for independence continued. In 1959, rioting broke out against Belgian rule. On June 30, 1960, Belgium hastily granted the colony independence. The new country was called Congo.

In Congo's first general elections—held about a month before independence—nine political parties won seats in the national legislature. No party received an overall majority. This splitting of votes weakened the power and

Important dates in Congo

A.D. 700's Advanced civilizations grew up in what is now Congo.
c. 1400 Kongo and other kingdoms grew up in the area.
Early 1500's The slave trade began in what is now Congo.
1885 King Leopold II of Belgium took control of the area and named it the Congo Free State.
1908 The Belgian government took control of the Congo Free State and renamed it the Belgian Congo.
1960 The Belgian Congo gained independence from Belgium and was renamed Congo.
1965 President Joseph Mobutu came to power and established a one-party state.
1971 The country's name was changed to Zaire.
1977 and 1978 Katanga rebels invaded Zaire from Angola, but were defeated.
1997 Rebels led by Laurent Kabila overthrew President Mobutu and renamed the country the Democratic Republic of the Congo.
1998 Fighting began in eastern Congo against the Kabila government.

unity of Congo's government. In a compromise on the eve of independence, two opposing leaders agreed to share power. Joseph Kasavubu became president and Patrice Lumumba became prime minister.

Civil disorder broke out in Congo following independence. Belgian officers still held power in the army, and many Belgians kept important government posts. Five days after independence, Congolese army troops near Léopoldville (now Kinshasa) revolted against their Belgian officers. Most Belgian officials fled the country.

In July 1960, Katanga Province (now the Shaba Region) *seceded* (withdrew) from the new nation. This copper-producing province ranked as Congo's wealthiest area. The diamond-producing province of Kasai seceded in August. In September, President Kasavubu dismissed Prime Minister Lumumba. Lumumba was imprisoned and, in 1961, he was assassinated. Lumumba's supporters established a rival government to that of Kasavubu.

Fighting broke out between the rival groups in Congo. United Nations (UN) troops—at the invitation of the Congolese government—were sent to the country to restore order in 1960. In August 1961, the rival groups reached a compromise that united all of the country except Katanga Province. Cyrille Adoula headed the new government as prime minister.

United Nations troops finally ended the Katanga secession in 1963. The UN forces were withdrawn in June 1964. In a surprising political settlement in July, Moise Tshombe, who had led the Katanga secession movement, became prime minister of the reunited country.

National elections were held in March 1965. A loose coalition headed by Tshombe won the elections. But the coalition soon fell apart. In November, the Congolese army took control of the government. General Joseph Désiré Mobutu became president.

Rebuilding the nation. Fighting among the country's people resulted in bitterness and deep divisions. President Mobutu tried to solve Congo's problems. He set up a strong national government that extended its authority in Congo. His party, the MPR, became the country's only political party. The government's authority helped end the revolts by Lumumba supporters. It also helped lessen the ethnic divisions of earlier years.

Mobutu also tried to strengthen the nation by encouraging pride in its African heritage and reducing European influence. Many cities, towns, and physical features in the country had European names. Mobutu's government gave all of these African names. In 1971, the government changed the country's name from Congo to Zaire. The government also required all Africans in the country who had European names to adopt African ones. Mobutu changed his own name from Joseph Désiré Mobutu to Mobutu Sese Seko in 1972.

In 1977, Katanga rebels who had been living in Angola invaded Zaire in an attempt to overthrow Mobutu. Zairian government troops, aided by Moroccan troops and French military equipment, defeated the rebels. Katanga rebels invaded Zaire again in 1978 but were defeated. French and Belgian troops helped the Zairian forces.

The fall of Mobutu. During the 1980's, severe economic problems and a lack of political freedom resulted in growing public dissatisfaction in Zaire. The standard of living for most Zairians grew worse, and many government services deteriorated. In 1990, public pressure led Mobutu to permit the formation of opposition political parties. In 1991, looting by mutinous soldiers and rioting by civilians forced Mobutu to agree to give up his monopoly on power. He agreed to share control with a prime minister and a cabinet, which would include several members of opposition parties.

In 1992, a conference consisting of representatives from opposition parties and other groups elected Etienne Tshisekedi, a Mobutu opponent, as prime minister. That year, the conference also elected a legislature. But Mobutu did not give Tshisekedi's government any real authority. In 1993, Mobutu dismissed Tshisekedi, and a new prime minister was appointed. But Tshisekedi and the legislature refused to accept the dismissal. Fighting broke out in southeastern Zaire between supporters and opponents of Mobutu. In January 1994, Mobutu again dismissed the prime minister. He also dissolved the legislature and formed a new one. A new prime minister was elected by the legislature in June, but Tshisekedi refused to recognize the election.

In 1994, more than 1 million Hutu refugees fled to eastern Zaire to escape Tutsi forces in Rwanda who had taken control of Rwanda's government. The refugee camps in Zaire soon fell under the control of Hutu extremist militias, many of whom had been responsible for that year's *genocide* (systematic killing) of about 800,000 people, mostly Tutsi, in Rwanda. In 1996, the Hutu extremists began attacking Tutsi in Zaire with the support of Zairian soldiers. Tutsi militias fought back with the support of Rwanda and Uganda.

In September 1996, fighting broke out in eastern Zaire between government troops and rebels. The rebels won a series of victories and pushed westward. In May 1997, Mobutu fled the country, and the rebel forces entered Kinshasa. Rebel leader Laurent Kabila then declared himself president and established a transitional government. He renamed the country the Democratic Republic of the Congo. Mobutu died of cancer in September 1997.

Recent developments. In August 1998, an uprising began in eastern Congo against the Kabila government. Troops from Rwanda and Uganda backed the rebels. Forces from Angola, Namibia, and Zimbabwe fought on the side of Kabila. In 1999, a cease-fire agreement was signed by Congo, the other countries involved in the war, and the two rebel groups fighting the Kabila government. But the agreement was violated by all the countries and rebel groups, and fighting continued.

In January 2001, one of Kabila's bodyguards assassinated him. Kabila's son Joseph became president. Later that year, troops on both sides of the war began retreating from front-line positions in Congo. Michael Chege

Related articles in *World Book* include:

Africa (pictures)
Clothing (picture: Traditional costumes)
Congo River
Kinshasa
Lake Albert
Lake Tanganyika
Luba
Mobutu Sese Seko
Mythology (picture: Fetish figures)
Sculpture (African sculpture)
Stanley and Livingstone

Outline

- C. Way of life
- D. Housing
- E. Clothing
- F. Food and drink
- G. Recreation
- H. Religion
- I. Education
- J. The arts

III. Land and climate

- A. The tropical rain forest
- B. Savannas
- C. The highland
- D. Rivers and lakes
- E. Animal life

IV. Economy

- A. Mining
- B. Agriculture and forestry
- C. Manufacturing
- D. Foreign trade
- E. Transportation and communication

V. History

Questions

What is Congo's most important economic activity?
What was the name from 1971 to 1997 of the country now called Congo?
Why is farm production low in Congo?
What were the roles of Henry M. Stanley and King Leopold II in the area's history?
What is the chief river in Congo?
What are the best-known Congolese works of art? Why have critics praised them?
Why do few people live in Congo's tropical rain forest?
What is the most important means of communication in Congo?
How did the government seek to protect wild animals?
Who were the first inhabitants of what is now Congo?

Congo River is the fifth longest river in the world. It flows 2,900 miles (4,667 kilometers) through west-central Africa. It carries more water than any river except the Amazon. The Congo River drains an area of about 1,400,000 square miles (3,630,000 square kilometers).

The Congo River begins south of Kabalo in Congo (Kinshasa), where the Lualaba and the Luvua rivers meet. From this point until Stanley Falls, the river is often called the Lualaba. After it passes over Stanley Falls near Kisangani in Congo (Kinshasa), the river is called the Congo.

Near Stanley Falls, the river turns westward and flows across northern Congo (Kinshasa). Several major rivers, including the Aruwimi, Lomami, and Ubangi, empty into the Congo. Near Mbandaka in Congo (Kinshasa), the Congo turns southwestward. It then forms the border between Congo (Kinshasa) and Congo (Brazzaville) for about 500 miles (800 kilometers). The Kasai River joins the Congo about 300 miles (480 kilometers) southwest of Mbandaka. Near Kinshasa, the Congo widens, creating a lake called Stanley Pool. The river then drops about 800 feet (240 meters) as it forms a series of 30 waterfalls between Kinshasa and Matadi in Congo (Kinshasa). The Congo empties into the Atlantic Ocean about 90 miles (140 kilometers) west of Matadi.

WORLD BOOK map

Location of the Congo River

Unlike the Mississippi and the Nile, the Congo River has no delta. The Congo's muddy waters flow into a deep trench that extends far into the Atlantic Ocean.

The Congo is the main waterway of Congo (Kinshasa). Commercial ships use the river between the Atlantic and Matadi and between Kinshasa and Kisangani. The river serves as a major transportation route for the people of Congo (Kinshasa), especially in areas that have few good roads. Rapids prevent navigation in some parts of the upper Congo.

In 1483, the Portuguese navigator Diogo Cão became the first European to reach the mouth of the Congo. Portuguese settlers established an outpost on the southern shore of the river near the Atlantic Ocean in the 1490's. But Europeans knew little about the rest of the river until after the British explorer Sir Henry M. Stanley completed an expedition from its source to its mouth in 1877. Robert I. Rotberg

See also **Congo (Kinshasa)** [picture: The Congo River]; **Stanley and Livingstone.**

Congregationalists are members of a Protestant religious group. From 1620 to about 1800, the Congregationalists were the dominant religious tradition in New England. Unlike many other Christian denominations, Congregationalists rejected outside control by bishops and councils. They believed that each congregation should control its own affairs, including the selection of ministers. This principle strongly influenced the development of democratic government in the United States.

Congregational practices developed in England during the early 1600's as a branch of Puritanism. Puritanism was a movement that attempted to "purify" the Church of England of Roman Catholic beliefs and practices. The Puritans were influenced by the teachings of John Calvin, a leader of the Protestant Reformation.

Some Puritans, called Separatists, broke away completely from the Church of England because they believed they could not reform it. The Pilgrims, a Separatist group, settled Plymouth Colony in 1620 in what is now Massachusetts. These Separatists later became known as Congregationalists because of their insistence on the rights of local congregations. They interacted with and finally merged with non-Separatist Puritans who settled in New England.

From the mid-1600's to the early 1800's, the Congregationalist doctrines of the Puritans dominated religious and cultural life in most of New England. Congregationalists later became known for their liberal social goals, their willingness to cooperate with other religious groups, and their emphasis on education. Several of the oldest colleges in the United States, including Harvard and Yale universities, were founded in part as schools for training Congregationalist ministers.

Congregationalism's strong emphasis on local control in local religious matters contributed to the development of American beliefs in democratic civil government. During the early 1700's, for example, John Wise and other Congregationalist ministers opposed efforts

by some religious and political leaders to deprive people of the right to direct their own affairs. Later, many Congregationalist ministers supported the cause of American independence.

During the 1800's, Congregationalism spread into the Midwestern and Western United States. However, Congregationalist churches in these areas later became Presbyterian. Also in the early 1800's, serious differences developed within the church between orthodox Congregationalists and a more liberal group called Unitarians. During the 1820's, many Congregationalist churches voted to become Unitarian and established their own association (see **Unitarians**). As a result, Congregationalism lost much of its influence in New England. Congregationalist churches formed a national council in 1871, but local congregations remained independent.

In 1931, Congregationalist churches merged with a union of three smaller groups to form the Congregational Christian Churches. These churches merged with the Evangelical and Reformed Church in 1957 to form the United Church of Christ. Several local churches in both groups did not join the merger. John F. Wilson

Related articles in *World Book* include:

Calvin, John
Edwards, Jonathan
Great Awakening
National Association of Congregational Christian Churches
United Church of Christ
Wise, John

Congress comes from a Latin word that means *a meeting*. Any group of people who represent organizations, regions, or nations, and who meet together to discuss their problems, may be called a congress. In the United States, the word *congress* usually refers to the Congress of the United States. An *international congress* is a conference attended by representatives of various nations. The name *congress* was given to several important international conferences that took place in the 1800's to determine boundaries and arrange political settlements in Europe. The most important were as follows:

Congress of Vienna (1814-1815), which divided up Napoleon's empire after the Napoleonic Wars.

Congress of Paris (1856), which settled the problems that grew out of the Crimean War. This congress also was an important step in the growing unity of Italy.

Congress of Berlin (1878), which took away from Russia Balkan land it had won from Turkey during the Russo-Turkish Wars. Michael P. Sullivan

See also **Berlin, Congress of; Congress of the United States; Continental Congress; Vienna, Congress of.**

Congress of Industrial Organizations (CIO) was an association of labor unions active from 1938 to 1955. In 1955, it merged with the American Federation of Labor (see **American Federation of Labor and Congress of Industrial Organizations**). Most CIO unions had members only in the United States, but a few international unions also had chapters, or locals, in Canada. Most CIO unions were *industrial unions,* rather than *craft unions.* The CIO organized all workers in a plant into one union rather than just the workers in one particular craft.

The CIO was originally a group called the Committee for Industrial Organization. In 1935, eight presidents of AFL unions formed the CIO to carry on an organizing drive in mass-production industries. The CIO signed up unskilled as well as skilled workers. It placed skilled workers in the industrial unions rather than assigning them to separate crafts unions. Some AFL leaders opposed the idea of industrial unions. But the CIO set up organizing committees and organized industrial unions in steel, automobile, rubber, and other major industries. The AFL did not accept these unions, and expelled unions that had taken part in the CIO. In 1938, the CIO formed its own federation and changed its name to the Congress of Industrial Organizations.

In its 1938 constitution, the CIO stated its main purposes: (1) to organize the unorganized; (2) to improve wages, hours, and working conditions; (3) to establish peaceful labor relations by forming unions strong enough to bargain with large industries; (4) to maintain collective bargaining and wage contracts; and (5) to secure legislation for the welfare of workers.

The Political Action Committee (PAC) of the CIO worked in national politics. State and city industrial councils were active in state and local politics. The CIO supported pro-labor political candidates and legislation.

CIO membership grew from about 4 million in 1938 to about 6 million in 1945. In 1949 and 1950, the CIO expelled 11 affiliated unions that it found to be dominated by Communists or by Communist sympathizers.

After many attempts at a merger, the CIO and AFL finally united in 1955. By then, the craft versus industrial union conflict had become less important. More than half of the AFL's members were in industrial unions. Rivalry among labor leaders lessened after the deaths in 1952 of William Green, president of the AFL, and Philip Murray, president of the CIO. When the two organizations merged, the CIO had about 5,800,000 members, the AFL about 10,200,000. Daniel Quinn Mills

See also **Dubinsky, David; Hillman, Sidney; Lewis, John L.; Murray, Philip; Reuther, Walter Philip.**

Congress of Racial Equality (CORE) is a civil rights organization in the United States. Its goals include equal rights, quality education, and economic and political opportunities for blacks.

When CORE was founded in 1942, it favored integration as a means of achieving its goals. In 1968, it changed its focus from integration to community control. CORE sought ways to enable the black community to control its schools and other institutions in order to provide quality goods and services for blacks.

Since the late 1970's, CORE has been involved in a number of lawsuits. A case in New Jersey ended in 1979 with a settlement in which CORE agreed to change its fund-raising methods. In 1981, CORE was found guilty of violating consumer rights in Alaska. In 1982, a New York lawsuit against CORE was settled out of court. The state attorney general had charged that CORE had collected funds for services to the poor that it did not provide. CORE headquarters are in New York City. Jacob Cohen

Congress of the Confederation is the name sometimes used for the national legislature established by the Articles of Confederation. Also known as the Confederation Congress, it operated the United States government from March 1, 1781, to March 4, 1789. The group's official title was the United States in Congress Assembled. But it replaced the Continental Congress, and many people continued to call it that. The Congress of the Confederation was replaced by the Congress established by the U.S. Constitution. See also **Articles of Confederation; Continental Congress.** William Morgan Fowler, Jr.



Architect of the Capitol

Congress, the lawmaking branch of the United States government, consists of the Senate and the House of Representatives. During a joint session, *shown here,* all members meet in the House chamber.

Congress of the United States

Congress of the United States makes the nation's laws. Congress consists of two bodies, the *Senate* and the *House of Representatives.* Both bodies have about equal power. The people elect Congress's members.

Although the most important task of Congress is making laws, it also has other major duties. For example, the Senate approves or rejects the U.S. president's choices for the heads of government departments, Supreme Court justices, and certain other high-ranking jobs. The Senate also approves or rejects treaties that the president makes.

Each member of Congress represents many citizens. Therefore, members must know the voters' views and be guided by them when considering proposed laws. Being a member of Congress also means answering citizens' letters, attending local events, and having local offices to handle people's problems with the government.

This article provides a broad description of Congress. For more information, see the separate *World Book* articles **House of Representatives** and **Senate.**

How Congress is organized

Congress is a *bicameral* (two-chamber) legislature. The 100-member Senate consists of 2 senators from each of the 50 states. The House of Representatives, usually called simply the *House,* has 435 members. House members, or *representatives,* are elected from *congressional districts* of about equal population into which the states are divided. Every state must have at least one House seat. Representatives are often called *congressmen* or *congresswomen,* though technically the titles also apply to senators.

The Democratic and Republican parties have long been the only major political parties in Congress. In each house of Congress, the party with more members is the *majority party.* The other one is the *minority party.* If a chamber is evenly split between the two parties, it has neither a majority nor a minority party. Before every new session of Congress, Republicans and Democrats in each house meet in what is called a *caucus* or *conference* to choose party leaders and to consider legislative issues and plans.

Committees form an important feature of each chamber's organization. They prepare the bills to be voted on. The committee system divides the work of processing legislation and enables members to specialize in particular types of issues. The majority party in each chamber elects the head of each committee and holds a majority of the seats on most committees.

The Senate. According to Article I, Section 3 of the Constitution, the vice president of the United States serves as head of the Senate with the title *president of the Senate.* However, the vice president is not considered a member of that body and rarely appears there, except on ceremonial occasions or to break a tie vote. The Senate elects a *president pro tempore* (temporary president) to serve in the vice president's absence. The Senate usually elects the majority party senator with the longest continuous service. The president pro tempore signs official papers for the Senate but presides infrequently. Most of the time, the president pro tempore appoints a junior senator as temporary president.

Democrats and Republicans each elect a chief officer

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called a *floor leader.* A floor leader is also known as the *majority leader* or the *minority leader,* depending on the senator's party. Each party elects an officer called a *whip* to assist the floor leaders. Floor leaders or whips are typically at their desks at the front of the chamber. They arrange the Senate's schedule, work for passage of their party's legislative program, and look after the interests of absent senators.

All senators treasure their right to be consulted on bills, to offer amendments, and to speak at length in debate. Just one senator can slow down or halt the work of the Senate. Thus, Senate leaders spend much time considering fellow senators' needs and arranging compromises that will enable the work of the chamber to go on.

Sixteen permanent *standing committees* and several temporary *special* or *select committees* help the Senate make laws. Most committees have *subcommittees* to handle particular topics. Typically, a senator sits on about four committees and six subcommittees.

The House of Representatives. The *speaker of the House,* mentioned in Article I, Section 2 of the Constitution, serves as presiding officer and party leader. The majority party nominates the speaker, who is then elected by a party-line vote of the entire House. The speaker is the most important member of Congress because of the office's broad powers. The speaker refers bills to committees, names members of special committees, and nominates the majority party's members of the powerful Rules Committee. The speaker votes in case of ties and grants representatives the right to speak during debates. With the help of assistants, the speaker also influences committee assignments, arranges committee handling of bills, and schedules bills for House debate. As in the Senate, the House majority and minority parties each choose a floor leader and a whip.

The House has 19 standing committees and several special or select committees. Except under certain circumstances, a representative is limited to serving on 2 standing committees and 4 subcommittees.

When Congress meets. A new Congress is organized every two years, after congressional elections in November of even-numbered years. Voters elect all the representatives, resulting in a new House of Representatives. About a third of the senators come up for election every two years. The Senate is a *continuing body* because it is never completely new. Beginning with the First Congress (1789-1791), each Congress has been numbered in order. The lawmakers elected in 2002 made up the 108th Congress.

Congress holds one regular session a year. The session begins on January 3 unless Congress sets a different date. Congress recesses often so members can visit their home states or districts. Congress adjourns in early fall in election years and in late fall in other years. After Congress adjourns, the president may call a *special session.* The president may adjourn Congress only if the two houses disagree on an adjournment date.

The Senate and the House meet in separate chambers in the Capitol in Washington, D.C. The building stands on Capitol Hill, often called simply *the Hill.* Senators and representatives occasionally meet in a *joint session* in the larger House of Representatives chamber, mainly to hear an address by the president or a foreign official. The Constitution requires Congress to meet jointly to count the electoral votes after a presidential election. Legislation is never acted on in a joint session.

Congress's power to make laws

Origin of power. The Constitution gives Congress "all legislative powers" of the federal government. At the heart of Congress's lawmaking powers is its "power of the purse"—its control over government taxing and spending. Article I, Section 8 of the Constitution lists a wide range of powers granted to Congress. These *delegated,* or *expressed, powers* include the authority to coin money, regulate trade, declare war, and raise and equip military forces.

Article I, Section 8 also contains an *elastic clause* that gives Congress authority to "make all laws which shall be necessary and proper" to carry out the delegated powers. The elastic clause grants Congress *implied powers* to deal with many matters not specifically mentioned in the Constitution. For example, Congress has the expressed power to coin money. It has the implied power to create a treasury department to print money.

Limitations of power. Congress is limited in the use of its powers. The Constitution prohibits some types of laws outright. For example, Congress may not pass trade laws that favor one state of the United States over another. The Bill of Rights, the first 10 amendments to the Constitution, forbids certain other laws. For instance, the First Amendment bars Congress from establishing a national religion; preventing religious freedom; or limiting freedom of speech, press, assembly, or petition.

The executive and judicial branches of government also limit Congress's powers. The president may veto any bill Congress passes. Congress can *override* (reverse) a veto only by a two-thirds vote in each chamber, which is usually difficult to obtain. The president's pow-

Facts in brief about members of Congress

Number: The Senate has 100 members, and the House of Representatives has 435.

Qualifications: Senate: (1) at least 30 years old, (2) a U.S. citizen for at least 9 years, and (3) a resident of the state from which the candidate seeks election. House: (1) at least 25 years old, (2) a U.S. citizen for at least 7 years, and (3) a resident of the state from which the candidate seeks election.

Nomination: Nearly all candidates for Congress are nominated in primary elections. A few are chosen by party conventions.

Election: A senator is elected by the voters from all parts of the state. A representative is elected by the voters of one congressional district of the state. If the state has only one House seat, voters from the whole state elect the state's representative.

Term: Senators are elected to six-year terms, and representatives to two-year terms. There is no legal limit to the amount of time a member of Congress can serve. In the early 1990's, some states passed laws limiting the number of terms or years their senators and representatives could serve. But in 1995, the Supreme Court of the United States ruled that it was unconstitutional for the states to set term limits for Congress.

Income: The speaker of the House receives $192,600 a year. Majority and minority leaders of the House earn $166,700 a year. All other members of the House receive $150,000. In the Senate, the president pro tempore and the majority and minority leaders earn $166,700 a year. All other senators receive $150,000. All members of Congress receive allowances for office expenses, staff salaries, travel, and similar expenses.

Removal from office: Members of Congress may be expelled by a two-thirds vote of their particular chamber.

er to propose legislation acts as another check on Congress. By its implied power of *judicial review,* the Supreme Court may declare a law passed by Congress to be unconstitutional. The courts also shape laws through their interpretations of them.

Finally, the power of public opinion limits what Congress can do. Lawmakers know that their actions must, in general, reflect the will of the people.

How Congress makes laws

Congress passes and the president signs about 600 laws during every two-year Congress. During that period, senators and representatives introduce up to 10,000 bills. The legislative process sifts the proposals at every stage in the development of a bill to a law. To be enacted, a bill must survive committee and floor debates in both houses. It often must win the support of *special-interest groups,* or *lobbies.* A lobby represents a particular group, such as farmers or labor unions, and tries to influence legislators to pass laws favorable to that group. A bill must also gain a majority of votes in Congress and the president's signature. If the president vetoes the bill, it needs overwhelming support in Congress to override the veto.

Proposing new laws. Laws can be proposed by anyone, including lawmakers or their staffs, executive officials, or special-interest groups. The president can propose laws in speeches or public appearances. At a national convention, a political party may suggest laws to reflect the party's position on major issues. But to become a law, a bill must be sponsored and formally introduced in Congress by a member. Any number of senators or representatives may co-sponsor a bill.

A bill may be *public* or *private.* A public bill deals with matters of concern to people in general. Such matters include taxation, national defense, and foreign affairs. A private bill applies only to specific individuals, as in an immigration case or a claim against the government. To become a law, either kind of bill must be passed in exactly the same form by both houses of Congress and then signed by the president. Each proposed bill is printed and assigned a number, such as S. 1 in the Senate and H.R. 1 in the House of Representatives. Bills are also often known by popular names or by the names of their sponsors or authors.

Working in committees. After being introduced, a bill goes to a committee that deals with the matters the bill covers. Some bills involve various subjects and may be handled by several committees. For example, a trade bill may include sections on taxes, commerce, and banking. The bill may thus interest congressional tax, commerce, and banking committees.

The chief congressional committees are the 16 Senate and the 19 House standing committees. They handle most major fields of legislation, such as agriculture, banking, foreign policy, and transportation. Most standing committees have subcommittees, which hold hearings and work on bills on specialized matters.

The select and special committees of Congress propose laws on particular subjects or conduct investigations. In 1987, for example, each house appointed a select committee to examine the Iran-contra affair. The affair involved the sale of U.S. weapons to Iran in exchange for hostages, and the use of profits from the weapons sale to help the contra rebel forces in Nicaragua. *Joint committees* have members from both the House and the Senate. Such committees handle mainly research and administrative matters.

A proposed law reaches a critical stage after being referred to a committee. Committees *report* (return) only about 15 percent of all bills they receive to the full Senate or House for consideration. Most bills are *tabled,* or *pigeonholed*—that is, never acted on. A committee's failure to act on a bill almost always spells death for the measure.

If committee leaders decide to proceed with a bill, they usually hold public hearings to receive testimony for and against the proposal. Testimony may be heard from a range of people, such as members of the president's Cabinet, scholars, representatives of special-interest groups, or lawmakers themselves.

Some bills go from committee to the full House or Senate without change. But most bills must be revised in committee *markup* sessions. In a markup session, members debate the sections of a measure and write amendments, thereby "marking up" the bill. When a majority of the committee's members vote for the revised bill, they report it to the full chamber with the recommendation that it be passed.

Legislative bargaining. To gain passage of a congressional bill, its sponsors must bargain for their fellow lawmakers' support. They need to give other legislators good reason to vote for the measure. To win a majority vote, the bill must be attractive to members with widely differing interests. Skillful legislators know how to draft a bill with broad appeal.

In a bargaining technique called *compromise,* legislators agree to take a position between two viewpoints. For example, lawmakers who want a major new government program and those who oppose any program at all might agree on a small trial project to test the idea.

In another form of legislative bargaining, called *pork barrel,* a bill is written so that many lawmakers benefit.

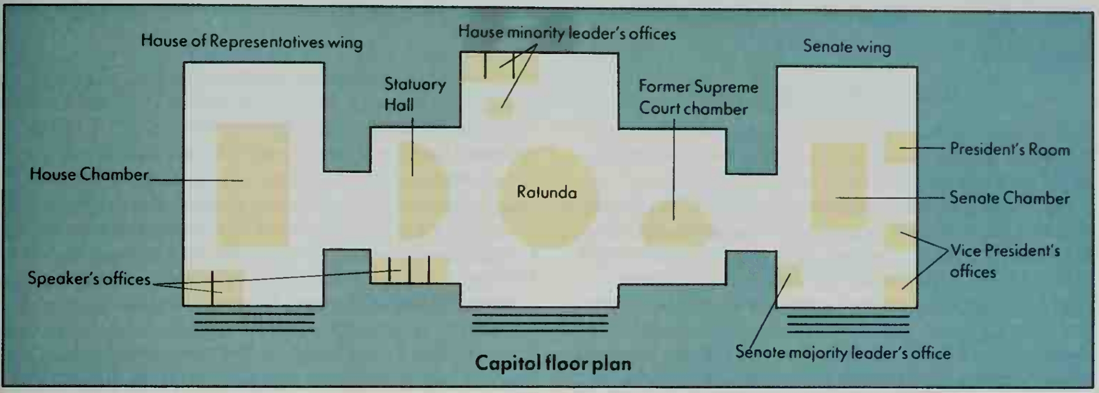
Standing committees of Congress

Senate	House of Representatives
Agriculture, Nutrition, and Forestry	Agriculture
Appropriations	Appropriations
Armed Services	Armed Services
Banking, Housing, and Urban Affairs	Banking and Financial Services
Budget	Budget
Commerce, Science, and Transportation	Commerce
Energy and Natural Resources	Education and the Workforce
Environment and Public Works	Government Reform
Finance	House Administration
Foreign Relations	International Relations
Governmental Affairs	Judiciary
Health, Education, Labor and Pensions	Resources
Judiciary	Rules
Rules and Administration	Science
Small Business	Small Business
Veterans' Affairs	Standards of Official Conduct
	Transportation and Infrastructure
	Veterans' Affairs
	Ways and Means



Shostal

The buildings where Congress works include the United States Capitol (1), the House office buildings (2), and the Senate office buildings (3). The floor plan shows the layout of the Capitol. The House of Representatives wing, *left,* includes the House Chamber, where the House holds its sessions. Senators meet in the Senate Chamber, located in the Senate wing, *right.*



WORLD BOOK diagram

For instance, a 1987 highway bill in the House included projects in so many members' districts that few representatives dared vote against it.

Some congressional bargaining involves an exchange of support over time. Lawmakers may vote for a fellow member's bill expecting that they will need that person's support later on another measure. This mutual help in passing bills is called *logrolling.*

In other instances, a member who is ill-informed on a bill may follow the lead of a lawmaker who is an expert on the subject. Some other time, the influence may flow the other way. This technique is called *cue giving* and *cue taking.* Lawmakers cannot be experts on every bill. They rely on associates who have worked on the bill.

Passing a bill. After a committee reports a bill, it is placed on a *calendar* (list of business) of whichever house of Congress is considering it. The Senate assigns all public and private bills to one calendar. It has a separate calendar for matters originating in the executive branch, such as treaties and presidential appointments. The House has four regularly used calendars. They involve (1) bills that raise or spend money, (2) all other major public bills, (3) private bills, and (4) noncontroversial bills.

Committees screen out bills that lack broad support. Therefore, most measures that reach the House or Senate floor for debate and voting eventually pass. The Senate usually considers a bill by a simple motion or by *unanimous consent*—that is, without anyone's objection. The objection of one senator can block unanimous consent, and so Senate leaders work to make sure the bill is acceptable to their associates. Senators, however, cherish their tradition of free and sometimes lengthy debate. Senators opposed to a bill may make *filibusters*—long speeches designed to kill the bill or force its sponsors to compromise. To halt a filibuster, the Senate can vote *cloture*—that is, to limit the debate.

The House considers most bills by unanimous consent, like the Senate, or by the *suspension-of-rules procedure.* Both methods speed up legislation on largely noncontroversial bills. Representatives consider controversial bills under rules made by the Rules Committee. The rules control debate on a bill by setting time limits, restricting amendments, and, occasionally, barring objections to sections of the bill. Debate time is divided between the bill's supporters and opponents.

Legislators use various methods to vote on a bill. In a *voice vote,* all in favor say aye together, and those opposed say no. In *division,* the members stand as a group to indicate if they are for or against a bill. In a *roll-call vote,* the lawmakers each vote yes or no after their name is called. The House usually records and counts votes electronically. Members vote by pushing a button.

Senators and representatives tend to vote according to their party's position on a bill. If legislators know the views of their *constituents* (the people who elected them), they may vote accordingly. The president and powerful lobbies also influence how members vote.

From bill to law. After a bill passes one house of Congress, it goes to the other. The second house approves many bills without change. Some bills go back to the first house for further action. At times, the second

house asks for a meeting with the first house to settle differences. Such a *conference committee* brings together committee leaders from both chambers to decide on the final bill. The two chambers then approve the bill, and it is sent to the President.

The President has 10 days—not including Sundays—to sign or veto a bill. The veto is most powerful when used as a threat—lawmakers working on a bill want to know if the President is likely to approve it. If the President fails to sign or return the bill within 10 days and Congress is in session, the bill becomes law. But if Congress adjourns during that time, the bill does not become law. Such action is called a *pocket veto.*

Presidents veto about 3 percent of the bills they get. Congress overrides only about 4 percent of all vetoes. Presidents may veto a bill because it differs from their legislative program, or because they feel it is unconstitutional, costs too much, or is too hard to enforce. See **Veto**.

Other duties of Congress

Passing laws lies at the heart of Congress's duties. But Congress also has nonlegislative tasks that influence national government and shape public policies.

Approving federal appointments. The Constitution requires the President to submit nominations of Cabinet members, federal judges, ambassadors, and certain other officials to the Senate for approval. A majority vote of the senators present confirms a presidential appointment. Senators approve almost all nominations to the executive branch because they believe that the President deserves loyal people in top jobs. The Senate examines judicial appointments more critically. About a fourth of all Supreme Court nominees have failed to win Senate confirmation. Some were rejected by a vote, but more commonly the Senate delayed acting on the nomination, often leading the President to withdraw it.

Approving treaties. According to Article II, Section 2 of the Constitution, the President has the power to make treaties "by and with the advice and consent of the Senate." A treaty requires the approval of two-thirds of the senators voting on it. The Senate has rejected very few treaties since the First Congress met in 1789.

The most famous treaty rejection was the Senate's refusal to approve the Treaty of Versailles, which established peace with Germany at the end of World War I (1914-1918). The treaty included President Woodrow Wilson's proposal for the League of Nations, an international association to maintain peace. Senators proposed reservations to the treaty—particularly the League—but Wilson rejected them, leading to the treaty's downfall.

In recent years, Presidents have tried to keep the Senate informed as they arrange treaties. For example, President Ronald Reagan invited senators to follow negotiations for the Intermediate-Range Nuclear Forces (INF) Treaty, which called for the elimination of certain U.S. and Soviet nuclear weapons. Objections from the senators sent U.S. diplomats back to the bargaining table to revise the treaty. Signed in December 1987, the treaty won Senate approval by the following May.

Conducting investigations. Congress has the implied power to investigate executive actions and public and private wrongdoing because such inquiries may lead to new laws. Congressional committees conduct the investigations. Congress has launched investigations to uncover scandals, spotlight certain issues, embarrass the President, or advance the reputations of the lawmakers themselves. Televised congressional investigations have aroused great public interest and highlighted Congress's role in keeping the people informed. In an early televised investigation in 1954, millions of TV viewers watched Senator Joseph R. McCarthy charge the U.S. Army with "coddling Communists."

Proposing constitutional amendments. Congress can propose amendments to the U.S. Constitution by a two-thirds vote in both houses. Congress can also call a constitutional convention to propose amendments if at least two-thirds of the states formally request it. In addition, Congress determines whether the states vote on an amendment by means of state legislatures or special state conventions. Congress also decides how long the states have to consider an amendment. It allows seven years in most cases.

Handling presidential election results. Congress counts and checks the votes cast by the Electoral College, the group of electors that chooses the U.S. President and Vice President. Congress then announces the results of the election. In most cases, the public knows the winners from the outcome of the popular election. If no candidate has a majority of Electoral College votes, Congress selects the winners. The House chooses the President, and the Senate elects the Vice President.

Impeaching and trying federal officials. An impeachment is a charge of serious misconduct in office. The House of Representatives has the power to draw up charges of impeachment against officials of the national government. If a majority of representatives vote for impeachment, the Senate then sits as a court to hear the charges against the official. Impeachments rarely occur. The House voted to impeach President Andrew Johnson in 1868, but the Senate narrowly acquitted him. President Richard M. Nixon resigned in 1974 before representatives voted on impeachment charges recommended by the House Judiciary Committee. In 1998, Bill Clinton became the second President to be impeached. But the Senate acquitted him the following year.

Reviewing its own members. Congress can review the election and judge the qualifications of its own members. It can also *censure* (officially condemn) or expel members for improper conduct as well as apply a milder form of discipline, such as a fine or reprimand. Congress has censured members for such reasons as the conviction of crimes, *unethical* (morally wrong) conduct, or disgracing Congress.

Members of Congress at work

A typical day. The daily schedule of members of Congress reflects their jobs both as lawmakers and as representatives for their districts and states. Most members work at least 11 hours a day. Mornings involve office work and committee meetings, often with two or three meetings scheduled at the same time. Members choose which meeting to attend. They make brief appearances at other meetings or send aides. During the afternoon, and during many mornings and evenings, the Senate and House are in session. Most legislators, busy with other work, do not stay in their particular chamber for debates. Instead, they follow them on

Representation in Congress

The Constitution of the United States provides for a *bicameral* (two-chamber) legislature. In the Senate, each state has equal representation—two senators per state. In the House of Representatives, population determines the number of representatives sent from each state.

State	Senate	House	State	Senate	House	State	Senate	House
Alabama	2	7	Louisiana	2	7	Ohio	2	18
Alaska	2	1	Maine	2	2	Oklahoma	2	5
Arizona	2	8	Maryland	2	8	Oregon	2	5
Arkansas	2	4	Massachusetts	2	10	Pennsylvania	2	19
California	2	53	Michigan	2	15	Rhode Island	2	2
Colorado	2	7	Minnesota	2	8	South Carolina	2	6
Connecticut	2	5	Mississippi	2	4	South Dakota	2	1
Delaware	2	1	Missouri	2	9	Tennessee	2	9
Florida	2	25	Montana	2	1	Texas	2	32
Georgia	2	13	Nebraska	2	3	Utah	2	3
Hawaii	2	2	Nevada	2	3	Vermont	2	1
Idaho	2	2	New Hampshire	2	2	Virginia	2	11
Illinois	2	19	New Jersey	2	13	Washington	2	9
Indiana	2	9	New Mexico	2	3	West Virginia	2	3
Iowa	2	5	New York	2	29	Wisconsin	2	8
Kansas	2	4	North Carolina	2	13	Wyoming	2	1
Kentucky	2	6	North Dakota	2	1			

Figures reflect the 2002 congressional reapportionment based on population totals from the 2000 census.

closed-circuit TV. Members must be ready to go to their chamber for a vote or a *quorum call*—that is, a count taken to determine if the minimum number of lawmakers needed to hold a vote is present.

Telephone calls, letters, and visits from constituents take up much of a legislator's time. Many people contact members of Congress to give their views on bills. Other people seek help with jobs, immigration problems, social security payments, or appointments to military academies.

Senators and representatives have assistants in their Washington, D.C., offices and in their state or district offices. The size of a senator's staff depends on the population of the senator's state—the larger the population, the larger the staff. The average staff consists of about 40 to 50 people. By law, representatives may employ up to 18 aides. Party and committee leaders in Congress have additional aides. Most members also accept students who work without pay to gain political experience. The students work either in Washington or in local offices on legislation and relations with constituents.

Congressional travel. Members of Congress travel often to their home states or districts to appear at public events, study area problems, and talk with voters or local officials. In fact, about a third of all representatives return to their districts nearly every weekend. Sessions of the Senate and House are scheduled to accommodate the members' need to appear frequently before their constituents, and legislators receive allowances to cover their expenses. If members fail to visit their home states or districts fairly often, they are apt to be criticized for forgetting their constituents.

Fact-finding missions at home or abroad—sometimes called *junkets*—also crowd the schedules of senators and representatives. Critics charge that legislators enjoy foreign travel at public expense. Legislators argue that experience gained by travel abroad helps them understand world developments and legislate wisely.

Social responsibilities. Membership in Congress carries many social obligations. Both at home and in Washington, individuals and groups interview legislators and expect them to attend social events.

History of Congress

The founding of Congress grew out of a tradition of representative assemblies that was brought from England and took root in the American Colonies in the early 1600's. Colonial assemblies had a wide range of powers, including authority to collect taxes, issue money, and provide for defense. In time, the assemblies increasingly voiced the colonists' interests against those of the British-appointed colonial governors.

As tensions worsened between Britain and the American Colonies in the 1760's, the colonial assemblies took up the colonists' cause. The First Continental Congress met in Philadelphia in 1774. It drew lawmakers from every colony but Georgia and could be considered the colonists' first "national" assembly. In 1776, the Second Continental Congress declared the colonies' independence from Britain. It served as a temporary national government until 1781, when the states adopted the Articles of Confederation and set up a national legislature called the Congress of the Confederation. This body functioned without an independent executive or judicial branch and soon showed its weakness.

In 1787, the Constitutional Convention met to strengthen the Articles of Confederation. However, the delegates drew up a new plan of government instead—the Constitution of the United States. The power of the legislature remained important, but it was balanced by executive and judicial branches. The Constitution called for two chambers for the new Congress—earlier Congresses had one house—with equal representation in one chamber and representation by population in the other. The establishment of a two-house legislature became known as the *Great Compromise*. It solved a bitter dispute between delegates from small states, who favored equal representation for every state, and those from large states, who wanted representation based on state population.

Growth and conflict. When the new Congress met for the first time in New York City in 1789, the two chambers were small and informal. At the end of the First Congress, the Senate had only 26 members, and the House of Representatives 65. As new states joined the Union, the House grew faster than the Senate and developed strong leaders. Such House speakers as Henry Clay in the early 1800's and Thomas B. Reed in the late 1800's brought power and high honor to their office. They also increased the power of the House of Representatives. The Senate enjoyed a golden age from about the 1830's to the 1860's, when it had such great speechmakers as Clay, Daniel Webster, and John C. Calhoun. Those men and their fellow senators debated the existence of slavery in the United States and other burning issues of the day.

Relations between Congress and the president shifted wildly throughout the 1800's. Most presidents yielded to Congress and initiated few policies. During the early and middle 1800's, however, several strong presidents sought to deal with Congress as an equal. Thomas Jefferson worked with congressional supporters to enact legislation drafted by the executive branch. Andrew Jackson promoted his policies through *patronage*—that is, his authority to make federal job appointments—and through his use of the veto. Abraham Lincoln used emergency authority to force Congress to accept his policies during the American Civil War (1861-1865).

Congress recaptured power after each of the strong presidents. Following the Civil War, the House ruled supreme, and the speaker became almost as important as the president. The speaker became so strong that House members revolted in 1910 to limit the office's power.

Continued struggle for power. During the early to middle 1900's, voters elected several strong-willed individuals who established the president as a leader in the legislative process. These men included Presidents Theodore Roosevelt, Woodrow Wilson, and especially Franklin D. Roosevelt. Each proposed a package of new laws and worked to persuade or pressure Congress to enact that package. Congress began to rely increasingly on its committees to process legislation.

Relations between Congress and the presidency changed markedly in the late 1960's and early 1970's. Such events as the Vietnam War (1957-1975) and the Watergate scandal led Congress to limit the president's authority. The Vietnam War had never been officially declared by Congress. But Presidents Lyndon B. Johnson and Nixon, as commanders in chief of the nation's armed forces, had sent hundreds of thousands of U.S. troops into the conflict. Public opposition to the war spurred Congress to pass the War Powers Resolution in 1973 over Nixon's veto. The resolution restricts the president's authority to keep U.S. troops in a hostile area without Congress's consent. The law reasserted Congress's role in foreign affairs but has had mixed success in curbing the president's warmaking authority.

In 1973, a Senate select committee began hearings on the Watergate scandal, which involved illegal campaign activities during the 1972 presidential race. The investigation led the House to begin impeachment proceedings against President Nixon. In July 1974, the House Judiciary Committee voted to recommend three articles of impeachment against Nixon—for obstructing justice, abusing presidential powers, and illegally withholding evidence. Nixon resigned in August 1974, before the full House voted on the three charges. Congress further declared its authority in 1974, when it passed an act that restricts the president's freedom to *impound* (refuse to spend) funds for projects approved by Congress.

In 1996, Congress took the unusual step of trying to increase presidential power. It did so by passing a law to enable the president to veto some items in spending bills. The new power, known as the *line-item veto,* went into effect in 1997. Many members of Congress voted for the bill because they thought presidents might use it to block unneeded spending that Congress, under pressure from local groups, often included in federal legislation. In 1998, however, the Supreme Court ruled the line-item veto unconstitutional.

Later that year, the Republican-controlled House impeached President Bill Clinton, a Democrat. The House charged him with perjury and obstruction of justice. The charges stemmed from Clinton's efforts to deal with a federal investigation of an extramarital affair he had while in office. The Senate, also controlled by Republicans, acquitted Clinton of both charges in 1999. See **Clinton, Bill.**

Congressional ethics has been a main area of concern in recent years. In 1989, for example, House Speaker James C. Wright, Jr., resigned his seat after being accused of accepting improper gifts and of earning more income from outside sources than House rules permitted. In 1994, Representative Dan Rostenkowski was indicted on corruption charges and was forced to resign as chairman of the House Ways and Means Committee. In 1996, he pleaded guilty to some of the charges.

In 1997, Newt Gingrich became the first House speaker ever to be reprimanded by the House of Representatives. The House reprimanded and fined him for using tax-exempt donations for political purposes and for giving the House Ethics Committee false information about the money. In 2002, Representative James A. Traficant, Jr., was expelled from the House after being convicted on charges of bribery, racketeering, and tax evasion.

Many people have objected to Congress's ability to vote itself pay raises. In 1992, the last of the required number of states ratified the 27th Amendment to the Constitution of the United States. This amendment requires that whenever a raise is authorized, it may not take effect until after the next congressional election.

The soaring cost of congressional campaigns has led to growing public concern that members of Congress spend too much time raising money and that large donors have too much influence on policy decisions. Big donors include *political action committees* (PAC's). A PAC obtains voluntary contributions from members or employees of a special-interest group and gives the funds to candidates it favors. Roger H. Davidson

Related articles. See the articles **House of Representatives** and **Senate** and their *Related articles.* See also:

Articles of Confederation
Botanic Garden, United States
Capitol, United States
Congressional Budget Office
Congressional page
Congressional Record
Constitution of the U.S.
Continental Congress
Electoral College
Executive order
General Accounting Office
Government Printing Office
Impeachment

Library of Congress
Lobbying
Political action committee
President of the United States
Technology Assessment, Office of
Term limits
United States, Government of the

Outline

I. **How Congress is organized**
   A. The Senate
   B. The House of Representatives
   C. When Congress meets
II. **Congress's power to make laws**
   A. Origin of power
   B. Limitations of power
III. **How Congress makes laws**
   A. Proposing new laws
   B. Working in committees
   C. Legislative bargaining
   D. Passing a bill
   E. From bill to law
IV. **Other duties of Congress**
   A. Approving federal appointments
   B. Approving treaties
   C. Conducting investigations
   D. Proposing constitutional amendments
   E. Handling presidential election results
   F. Impeaching and trying federal officials
   G. Reviewing its own members
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   A. A typical day
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Questions

Why are there two houses of Congress?
In what ways is the power of Congress limited?
What powers does the speaker of the House have?
What are *delegated powers* of Congress? *Implied powers?*
How does Congress influence the president's treaty-making power?
What techniques are used in legislative bargaining?
How did relations between Congress and the presidency change markedly in the late 1960's and early 1970's?
Why does Congress conduct investigations?
What is a *standing committee?* A *conference committee?*
Why do members of Congress travel often to their home states or districts?

Additional resources

Level I
Kronenwetter, Michael. *The Congress of the United States.* Enslow, 1996.
Stein, R. Conrad. *The Powers of Congress.* Children's Pr., 1995.
Weber, Michael. *Our Congress.* Millbrook, 1994.

Level II
Christianson, Stephen G. *Facts About the Congress.* H. W. Wilson, 1996.
Congress A to Z. 3rd ed. Congressional Quarterly, 1999.
Guide to Congress. 2 vols. 5th ed. C Q Pr., 2000.

Congressional Black Caucus. See Black Caucus, Congressional.

Congressional Budget Office is an agency of the United States Congress. It provides members of Congress with information on the nation's economy, the federal budget, and federal programs. The office, often called the CBO, does not recommend policies. It presents optional plans and programs, and studies their possible impact on the budget.

Each year the CBO reviews and analyzes the president's budget proposals. It prepares a forecast of the cost of continuing for five years the existing federal policies affecting taxation and spending. Staff members of the CBO regularly testify before congressional committees on budget matters. The CBO helps budget committees in the Senate and the House of Representatives prepare biannual budget proposals. It keeps track of how closely congressional spending and revenue actions match budgeted goals. The office issues an annual report on major budgetary options.

The CBO was created by the Congressional Budget and Impoundment Control Act of 1974. Congress passed the act to affirm its constitutional authority over the United States budget.

Critically reviewed by the Congressional Budget Office

See also **Budget** (Preparation of the U.S. budget).

Congressional page works as a messenger in the United States Senate or House of Representatives. Pages carry messages between the Capitol and the Senate and House office buildings and run errands for the senators and representatives. Members of Congress appoint a limited number of young people from their home districts to work as pages. Pages range in age from 14 to 18 years. They are paid only for the periods the Senate or House is in session. Pages attend a special high school from 6:30 a.m. to 9:45 a.m. Kenneth Janda

Congressional Record is a printed account of what is done and said in the United States Congress daily. Each member of Congress finds on his or her desk in the morning a copy of the *Record* for the day before. The *Congressional Record* prints everything said in Congress, except during executive sessions of the Senate. Members of Congress may make changes in their speeches before they are printed in the *Record*, and so the *Record* is not a completely accurate account of what was said in Congress. They also can have material other than speeches before Congress printed in the *Record.*

The *Congressional Record* began in 1873. Three other publications record earlier events in Congress. *Annals of Congress* describes proceedings from 1789 to 1824. *Congressional Debates* covers 1824 to 1837, and the *Congressional Globe* records events from 1833 to 1873.

Today, anyone may subscribe to the *Congressional Record* or buy separate parts of it from the Superintendent of Documents, Government Printing Office, Washington, DC 20402. Kenneth Janda

Congressman or congresswoman is a member of the United States Congress. The term generally refers to a member of the House of Representatives. See also Address, Forms of; Congress of the United States.

Congresswoman. See Congressman.

Congreve, *KAHN greev,* **William** (1670-1729), was an English dramatist who wrote witty, sophisticated comedies. The best of his five plays are *Love for Love* (1695) and *The Way of the World* (1700). They contain lively and clever speeches as well as memorable characters and comic situations. They have a polished prose style and a civilized, realistic view of life. *The Way of the World* presents a satirical picture of a cultured, worldly high society. The play laughs at hypocrites, boors, would-be wits, fools, and aging coquettes. Congreve's most popular play during his lifetime was *The Mourning Bride* (1697), his only tragedy. It contains the famous line "Music has charms to soothe a savage breast."

Congreve was born in Yorkshire and grew up in Ireland. He entered law school in London in 1691 but preferred writing and the leisurely life of a man about town. He wrote little after 1700. Jack D. Durant

Congreve, *KAHN greev,* **Sir William** (1772-1828), a British inventor, developed rockets that could carry explosives. His work promoted the use of rockets as a major military weapon. The British used Congreve rockets against French troops during the Napoleonic Wars (1793-1815). British forces also bombarded Fort McHenry in Baltimore, Maryland, with such rockets during the War of 1812. See **Rocket** (Early rockets).

Congreve was born in Woolwich, England, and received a master's degree from Cambridge University in 1795. He succeeded to his father's baronet title in 1814. Congreve received 18 patents. He devised new methods of mounting naval guns and manufacturing gunpowder. He also invented a steam engine, a sprinkler system, and various other devices. Romualdas Sviedrys

Conifer, *KOH nuh fuhr* or *KAHN uh fuhr,* is any one of a large group of trees or shrubs that bears its seeds in cones. Most conifers have tall, straight trunks and narrow branches and grow in cold or cool climates. Conifers form about 30 percent of the world's forests. Common types include cedars, firs, larches, pines, redwoods, sequoias, and yews. The cycad plant also bears cones, but it is not considered a conifer (see **Cycad**).

Conifers rank among the oldest groups of woody plants. Conifer fossils have been found in rocks that are about 300 million years old. Conifers include the largest, tallest, and oldest living things. The largest giant sequoia is about 275 feet (84 meters) high, and the base of its trunk has a circumference of over 100 feet (30 meters). Redwoods, the tallest living trees, may tower more than 360 feet (110 meters) high. Some bristlecone pines are more than 4,600 years old.

Most conifers are evergreen and have small, needlelike leaves. Other conifers, including redcedars and cypresses, have tiny, scalelike leaves that cling to the stem. These trees are also evergreen. Larches and baldcypresses are conifers but lose their leaves every year.

Conifer cones range from less than $\frac{1}{2}$ inch (1.3 centimeters) long to more than 2 feet (61 centimeters) long. A few conifers have unusual, fleshy cones. Juniper seed cones resemble blueberries. Yew seed cones look like red berries with a single, large seed. Conifers have two types of cones—male and female. In most conifers, both types grow on the same plant. The soft male cones produce and release pollen, then shrivel and die. The female cones are larger and become woody with age. Each of their scales has two structures called *ovules,* which contain *eggs* (female reproductive cells). Wind carries pollen from the male cones to the female cones, where the pollen fertilizes the egg. The ovules then develop into seeds. After the seeds become fully formed, they fall from the cones.

Much of the wood used in buildings comes from conifers, including Douglas-fir and loblolly pine. Conifers also provide wood pulp for making paper and cardboard. In addition, millions of people use conifers as Christmas trees. Douglas G. Sprugel

Scientific classification. Conifers make up the order Coniferales in the plant kingdom, Plantae.

Related articles in *World Book* include:

Baldcypress	Cypress	Ginkgo
Balsam fir	Douglas-fir	Gymnosperm
Bristlecone pine	Evergreen	Hemlock
Cedar	Fir	Juniper
Larch	Piñon	Spruce
Monkey puzzle tree	Plant (pictures)	Tree (Needleleaf trees; pictures)
Pine	Redwood	Yew
	Sequoia	

Conjoined twins are twins connected to one another at some point of their bodies. The most common connections occur at the hip, chest, abdomen, buttocks, or head. Some such twins also share an internal organ, such as a heart or a liver. Conjoined twins are *identical*—that is, they are the same sex and have exactly the same *genes* (hereditary instructions in cells).

Scientists believe that conjoined twins develop from a single fertilized egg that fails to separate completely as it divides. If the growing cell masses separate fully, individual identical twins form. Doctors do not know why incomplete separation sometimes occurs.

Doctors can determine if a pregnant woman is carrying conjoined twins by means of X rays, *ultrasound* (high frequency sound waves), or other methods of diagnosis. Physicians deliver most conjoined twins by means of an operation called a *cesarean section.* In this procedure, the doctor removes the infants through an incision in the mother's abdomen and uterus. A cesarean section reduces the chance of injury to the mother.



Granger Collection

Chang and Eng were famous conjoined twins joined at the ribcage. They were born in Siam (now Thailand) in 1811 and died in 1874. The term *Siamese twins* originated with them.

Surgery to separate conjoined twins can be complex. Each case must be individually evaluated by a team of medical specialists. In many cases, the surgery results in the death of one or both of the twins.

Conjoined twins came to be called Siamese twins during the 1800's. That term originated with Eng and Chang, a set of conjoined twins from Siam (now Thailand). Eng and Chang appeared in traveling exhibitions and became internationally famous in the 1800's. The term "Siamese twins" came to be regarded as offensive by many people during the 1900's. Melvin V. Gerbie

See also **Multiple birth.**

Conjugation, *KAHN juh GAY shuhn,* is a complete list of the forms of a verb by mood, number, person, tense, and voice. A *synopsis* is a summary of these forms in

only one person, as shown below for the verb *show.*

Each verb form expresses a different shade of meaning. Progressive forms indicate an action in progress at any particular time ("The first film *was showing* when we arrived"). Emphatic forms may add a degree of emphasis, but they are used primarily to form questions ("*Does* it *show?*") and negative statements ("It *does* not *show*"). The imperative mood gives commands ("*Show* what it is like"). The subjunctive mood expresses urgency ("The people insisted that the film *be shown*"); wishing ("I wish it *were being shown* now"); or reflects a condition contrary to fact ("If the film *were shown,* we would be in trouble"). Patricia A. Moody

Indicative mood

Simple forms

Tense	Active voice	Passive voice
Present	it shows	it is shown
Past	it showed	it was shown
Future	it will show	it will be shown
Present perfect	it has shown	it has been shown
Past perfect	it had shown	it had been shown
Future perfect	it will have shown	it will have been shown

Progressive forms

Tense	Active voice	Passive voice
Present	it is showing	it is being shown
Past	it was showing	it was being shown
Future	it will be showing	*
Present perfect	it has been showing	*
Past perfect	it had been showing	*
Future perfect	it will have been showing	*

*No commonly accepted usage in this voice

Emphatic forms

Tense	Active voice only
Present	it does show
Past	it did show

Imperative mood

Used only in the second person, present tense

Active voice	Passive voice
[you] show	[you] be shown

Subjunctive mood

Tense	Active voice	Passive voice
Present	[if] it show	[if] it be shown
Past	[if] it showed	[if] it were shown
Future	[if] it will show	[if] it will be shown
Present perfect	[if] it has shown	[if] it has been shown
Past perfect	[if] it had shown	[if] it had been shown
Future perfect	[if] it will have shown	[if] it will have been shown

See also **Mood; Number; Person; Tense; Voice; Verb.**

Conjunction, *kuhn JUHNGK shuhn,* is a word used to connect words, phrases, clauses, and sentences. The term comes from two Latin words that mean *joined with.* There are two kinds of conjunctions, *coordinating* and *subordinating.*

Coordinating conjunctions connect grammatically equal words, phrases, clauses, or sentences as in the following examples. Words—"He ate bread *and* butter." Phrases—"In red coats *and* with loud drums, the soldiers came marching." Clauses or sentences—"He reads well, *but* his sister reads better."

Subordinating conjunctions join a subordinate clause to the principal clause of a sentence—elements that are not grammatically equal. "He can read better *than* I can." *Than* is a subordinating conjunction connecting the subordinate clause *I can* (*read* is understood) with the principal clause. Marianne Cooley

Conjunctivitis, *kuhn JUHNGK tuh VY tihs,* is an inflammation of the membrane that covers the white part of the eyeball and the inner lining of the eyelid. This membrane is called the *conjunctiva.* Conjunctivitis may be caused by bacteria, viruses, or other microbes. It also may result from allergies or chemical burns. Most types of conjunctivitis caused by infection are contagious.

Symptoms of conjunctivitis include burning, itching, watering and redness of the eye, and the sensation that an object is lodged under the eyelid. In addition, pus may form and the eyelids may stick together.

Acute conjunctivitis, called *pinkeye,* is usually caused by bacteria. In most cases, doctors can cure pinkeye quickly with antibiotics. Viral conjunctivitis usually does not respond to drugs, but many cases rapidly clear up by themselves. However, some types of viral conjunctivitis may last a long time and infect the *cornea,* the clear tissue at the front of the eye. Involvement of the cornea may decrease vision. Allergic conjunctivitis is frequently associated with hay fever. Cold compresses and medicated eyedrops help relieve the symptoms of allergic conjunctivitis. Conjunctivitis caused by exposure to chemicals can result in serious eye damage. In many cases, such damage can be minimized by immediately flushing the eye with water. Ronald Klein

Conjuring. See Magician.

Conly, Robert Leslie. See O'Brien, Robert C.

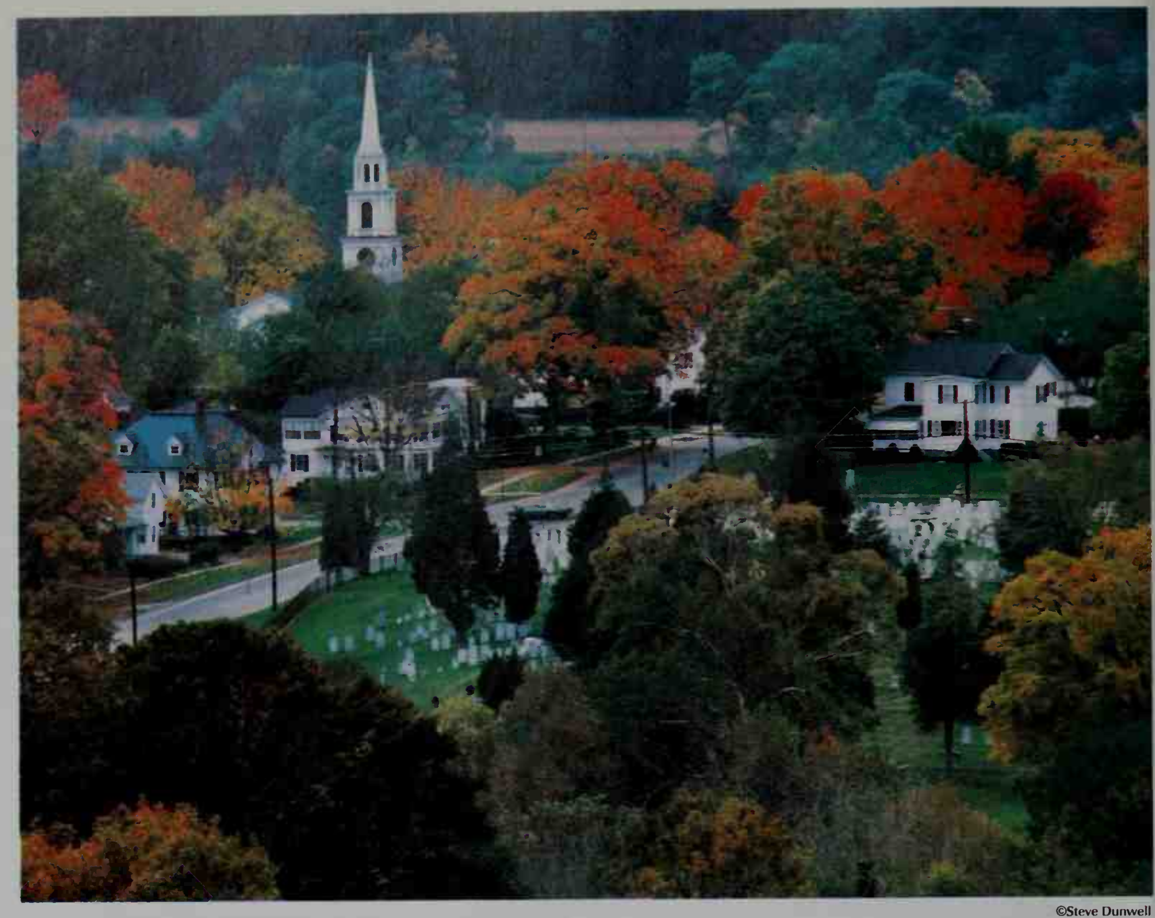
Connally, John Bowden (1917-1993), was United States secretary of the treasury in 1971 and 1972. He was the first Democrat appointed to the Cabinet by President Richard M. Nixon, a Republican. Connally served as governor of Texas from 1963 to 1969. In 1973, he became a Republican. He was an unsuccessful candidate for the 1980 Republican presidential nomination.

Connally was born in Floresville, Texas, and graduated from the University of Texas School of Law. After serving as a Navy lieutenant commander during World War II, he became the manager of a radio station in Austin, Texas, in 1946. During the 1950's, Connally was attorney for a Texas oil company.

In 1961, President John F. Kennedy named Connally secretary of the Navy. Connally resigned after 11 months to seek the Texas governorship. In 1963, he was seriously wounded while riding in Kennedy's car in Dallas when the president was assassinated. William J. Eaton

Connaught and Strathearn, Duke of (1850-1942), served as governor general of Canada from 1911 to 1916. He was the third son of Queen Victoria of Britain. Connaught's presence in Canada as governor general helped inspire patriotism there during the early years of World War I (1914-1918). During the war, Connaught helped reestablish the Canadian Patriotic Fund, which aided dependents of people serving in the Canadian armed forces.

Connaught was born in London. His full given name was Arthur William Patrick Albert, and he was known as Prince Arthur. In 1868, the prince became an army officer. During the late 1800's, he fought in Canada and Egypt and served with British troops in India and Ireland. In 1874, Prince Arthur became the Duke of Connaught and Strathearn. In the army, he became a general in 1893 and a field marshal in 1902. From 1907 to 1909, he served as commander in chief of British forces in and around the Mediterranean Sea. Jacques Monet



©Steve Dunwell

A Connecticut village in autumn is ablaze with the brilliant colors of turning leaves. Every year, many vacationers visit the state to enjoy its scenic countryside and to explore its many picturesque villages and historic sites.

Connecticut *The Constitution State*

Connecticut, *kuh NEHT ih kuht,* is the third smallest state of the United States. Only Delaware and Rhode Island have smaller areas. In spite of its small size, Connecticut is an important industrial state and a favorite vacationland. Hartford, the capital of Connecticut, is known as the *Insurance City.* A number of insurance companies have headquarters in Hartford. Bridgeport is Connecticut's largest city.

Connecticut is one of the nation's leading producers of aircraft parts, helicopters, and submarines. It also ranks high among the states in the production of cutlery and hardware. New Britain and New Haven are important hardware centers.

The mighty Connecticut River cuts through the center of the state. The river flows into Long Island Sound, Connecticut's outlet to the Atlantic Ocean. The word *Connecticut* comes from an Algonquian Indian word meaning *on the long tidal river.* The state's biggest industrial cities are west of the Connecticut River. They stretch from Hartford in central Connecticut to Stamford near the southwestern border of the state. New York City lies southwest of Connecticut. Thousands of Connecticut residents commute to work there.

Connecticut's rural areas and small towns contrast sharply with its industrial cities. Many towns in Connecticut center around a parklike area called a *green.* Near the green may stand a small white church, a town meeting hall, an old tavern, and several colonial houses. Forests, rivers, lakes, waterfalls, and a sandy shore add to the beauty of the state.

The people of Connecticut played an important role in U.S. history. For many years, colonial Connecticut was governed under the *Fundamental Orders,* sometimes regarded as the first written constitution. The Fundamental Orders later served as one of the models for the Constitution of the United States. At the Constitutional Conven-

The contributors of this article are Thomas R. Lewis, Associate Professor of Geography at the University of Connecticut, and Barbara M. Tucker, Professor of History and Director of the Center for Connecticut Studies at Eastern Connecticut State University.

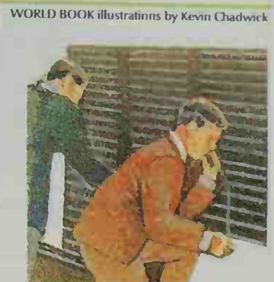
©Ray Hillstrom

City Place in Hartford, Connecticut's capital, is the state's tallest building. The 38-story office complex overlooks Bushnell Park and the Soldiers and Sailors Memorial Arch, *foreground.*

Interesting facts about Connecticut

WORLD BOOK illustrations by Kevin Chadwick

The first telephone exchange in the world, *right,* opened in New Haven on Jan. 28, 1878. The exchange, which had 21 subscribers, was developed by George W. Coy. Its customers placed their calls through an operator.



First telephone exchange

The Hartford Courant, one of Connecticut's chief newspapers, has been published continuously longer than any other newspaper in the United States. The *Courant* began publication in 1764.

The first cookbook written by an American was published in Hartford in 1796. The book was *American Cookery* by Amelia Simmons.



First accident insurance policy

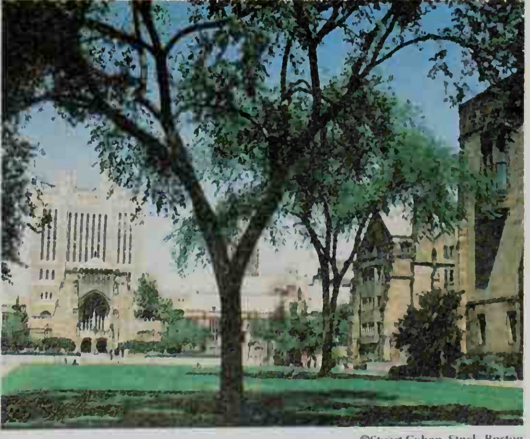
The first accident insurance policy sold in the United States, *above,* was issued on April 1, 1864, by James Goodwin Batterson of the Travelers Insurance Company of Hartford. Batterson sold the policy to James Bolter of Hartford as the two of them walked out of the Hartford post office. The policy covered only Bolter's two-block walk that day from the post office to his home on Buckingham Street. The $1,000 coverage provided by the policy cost Bolter 2 cents.

The football tackling dummy was invented at Yale University in New Haven in 1889. Amos Alonzo Stagg, its inventor, was a divinity student and a football player at Yale. He later became one of the most successful coaches in the history of college football.

tion of 1787, Connecticut delegates helped work out the *Great Compromise* or *Connecticut Compromise.* It broke a deadlock over how many representatives each state should elect to Congress. This compromise and the Fundamental Orders earned Connecticut the nickname of the *Constitution State.*

Connecticut's people also made important contributions to the nation's industrial development. Eli Whitney helped make Connecticut the birthplace of mass-production manufacturing. Working in Hamden, he showed the advantages of using interchangeable parts in gunmaking. Whitney's methods led to the high-speed industrial production of today.

Steel manufacturing in the United States began in Hartford County. Connecticut workers were also the first Americans to make bicycles, dyed silk, friction matches, printing type, repeating pistols, rubber shoes, and vulcanized rubber. The first insurance policies providing coverage for accidents, automobiles, and aircraft were written in Hartford. The *Nautilus,* launched in Groton in 1954, was the world's first nuclear-powered submarine.



©Stuart Cohen, Stock, Boston

Yale University's Memorial Quadrangle features beautiful architecture in the Gothic style. The university, located in New Haven, is the nation's third oldest institution of higher learning.

Connecticut in brief

Symbols of Connecticut

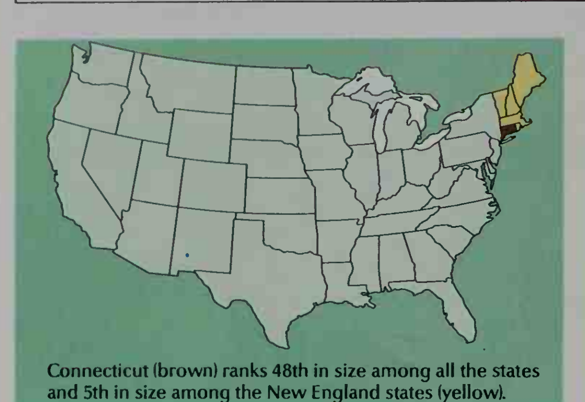
On the state flag, adopted in 1897, the three grapevines on the shield symbolize the colony brought from Europe and transplanted in the wilderness. The state motto beneath the shield, *Qui Transtulit Sustinet,* means *He Who Transplanted Still Sustains.* The present version of the state seal first appeared in 1784. The seal also bears three grapevines and the state motto.






State flag

State seal



Connecticut (brown) ranks 48th in size among all the states and 5th in size among the New England states (yellow).

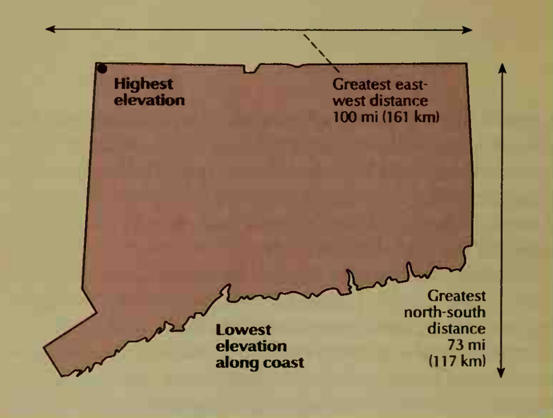
General information

Statehood: Jan. 9, 1788, the fifth state.
State abbreviations: Conn. (traditional); CT (postal).
State motto: *Qui Transtulit Sustinet* (He Who Transplanted Still Sustains).
State song: "Yankee Doodle." Composer unknown.

The State Capitol is in Hartford. New Haven and Hartford functioned as twin capitals from 1701 to 1875, when Hartford was named the only capital.

Land and climate

Area: 5,006 mi² (12,966 km²), including 161 mi² (416 km²) of inland water but excluding 538 mi² (1,392 km²) of coastal water.
Elevation: *Highest*—2,380 ft (725 m) above sea level, on the south slope of Mount Frissell. *Lowest*—sea level along the Long Island Sound shore.
Record high temperature: 106 °F (41 °C) at Danbury on July 15, 1995.
Record low temperature: −32 °F (−36 °C) at Falls Village on Feb. 16, 1943.
Average July temperature: 71 °F (22 °C).
Average January temperature: 26 °F (−3 °C).
Average yearly precipitation: 47 in (119 cm).



Important dates

1633 — The first English settlement in Connecticut was made in Windsor.

1662 — Connecticut received a charter from England that served as a constitution until 1818.

1776 — Connecticut passed a resolution in favor of independence from the United Kingdom on June 14.

1788 — Connecticut became the 5th state when it ratified the U.S. Constitution on January 9.



State bird
American robin

State flower
Mountain laurel

State tree
White oak

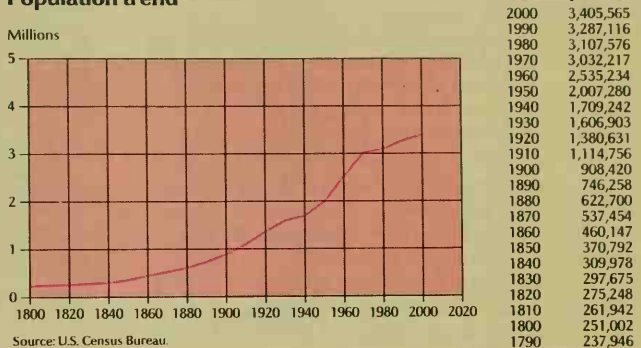
People

Population: 3,405,565 (2000 census)
Rank among the states: 29th
Population density: 680 per mi² (263 per km²), U.S. average 78 per mi² (30 per km²)
Distribution*: 79 percent urban, 21 percent rural
Largest cities in Connecticut

City	Population
Bridgeport	139,529
New Haven	123,626
Hartford	121,578
Stamford	117,083
Waterbury	107,271
Norwalk	82,951

Source: 2000 census, except for *, where figures are for 1990.

Population trend



Year	Population
2000	3,405,565
1990	3,287,116
1980	3,107,576
1970	3,032,217
1960	2,535,234
1950	2,007,280
1940	1,709,242
1930	1,606,903
1920	1,380,631
1910	1,114,756
1900	908,420
1890	746,258
1880	622,700
1870	537,454
1860	460,147
1850	370,792
1840	309,978
1830	297,675
1820	275,248
1810	261,942
1800	251,002
1790	237,946

Source: U.S. Census Bureau.

Economy

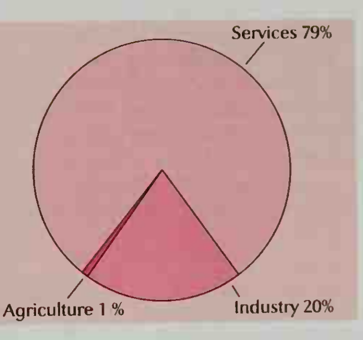
Chief products

Agriculture: greenhouse and nursery products, milk, eggs.
Manufacturing: transportation equipment, fabricated metal products, chemicals, machinery, computer and electronic products, electrical equipment, printed materials.
Mining: crushed stone.

Gross state product

Value of goods and services produced in 1998: $142,098,000,000. *Services* include community, business, and personal services; finance; government; trade; and transportation, communication, and utilities. *Industry* includes construction, manufacturing, and mining. *Agriculture* includes agriculture, fishing, and forestry.

Source: U.S. Bureau of Economic Analysis.



Government

State government

Governor: 4-year term
State senators: 36; 2-year term
State representatives: 151; 2-year term
Towns: 169 (no county governments)

Federal government

United States senators: 2
United States representatives*: 6 (5)
Electoral votes*: 8 (7)

*Figures in parentheses are for January 2003 and beyond.

Sources of information

For information about tourism, write to: Connecticut Office of Tourism: 505 Hudson Street, Hartford, CT 06106. The Web site at www.ctbound.org also provides information.

For information on the economy, write to: Department of Economic and Community Development, Research Division, 505 Hudson Street, Hartford, CT 06106.

The state's official Web site at www.state.ct.us also provides a gateway to much information on Connecticut's economy, government, and history.

1910 New London became the home of the U.S. Coast Guard Academy.

1954 The first nuclear submarine was launched in Groton.

1979 Connecticut passed a law banning construction of new nuclear power plants.

1991 Connecticut established an individual income tax.

People

Population. The 2000 United States census reported that Connecticut had 3,405,565 people. The population had increased 3 ½ percent over the 1990 figure, 3,287,116. According to the 2000 census, Connecticut ranks 29th in population among the 50 states.

About 96 percent of the people of Connecticut live in eight Metropolitan Statistical Areas (see **Metropolitan area**). These areas are Bridgeport, Danbury, Hartford, New Haven-Meriden, New London-Norwich, Stamford-Norwalk, Waterbury, and Worcester (Massachusetts). For the populations of these metropolitan areas, see the Index to the political map of Connecticut.

Bridgeport is Connecticut's largest city. Other large cities, in order of population, include New Haven, Hartford, Stamford, and Waterbury.

Connecticut's largest population groups include people of Italian, Irish, English, German, and Polish descent. African Americans and Hispanics each account for about 9 percent of the state's population.

Schools. Connecticut's Yale University, founded in 1701, is the third oldest institution of higher learning in the nation. Only Harvard University and the College of William and Mary are older. The Litchfield Law School (later called Tapping Reeve Law School) was the first U.S. institution devoted entirely to teaching law. Tapping Reeve, a judge, founded the school in his home in 1774. In 1784, he moved the school to a building next to his home. The school operated until 1833. In 1817, Thomas H. Gallaudet founded the first free American school for the deaf, in Hartford. The school now operates in West Hartford as the American School for the Deaf.

Before 1650, schools in Connecticut were voluntary. A law passed in 1650 required towns with at least 50 families to hire someone from the town to teach the children to read and write. Towns with at least 100 families were required to establish a school for more advanced study.

A commissioner of education and a 9-member State Board of Education supervise Connecticut's public school system. The governor appoints the board members to four-year terms, and the members elect the commissioner to the same term. The board also has two non-voting student members who serve one-year terms.

Connecticut law requires children to attend school from age 7 through 15. For the number of students and teachers in Connecticut, see **Education** (table).

Libraries. The Yale University Library, founded in 1701, is the oldest library still operating in Connecticut. It is one of the largest libraries in the world. The Scoville Memorial Library in Salisbury was founded in 1803 as the Bingham Library for Youth. In 1810, Salisbury began using taxes to support the library. It may have been the first free, tax-supported public library in the United States. Today, Connecticut's largest public libraries are located in Bridgeport, Hartford, and New Haven. The State Library in Hartford houses the state archives, many books about Connecticut, and a special law collection. Hartford also has law libraries and insurance libraries.

Museums. Yale's Peabody Museum has world-famous natural history exhibits. The Yale University Art Gallery is the oldest university art museum in the United States. The university also operates the Yale Center for British Art. The Barnum Museum in Bridgeport displays items and photographs from the attractions of Connecticut-born showman P.T. Barnum. Exhibits at the Mystic Seaport Museum of America and the Sea in Mystic include historic ships and photographs. The American Clock and Watch Museum in Bristol displays timepieces made in the 1700's and 1800's. The New Haven Colony Historical Society exhibits the original model of Eli Whitney's cotton gin. It also owns valuable prints and early American portraits. The Mashantucket Pequot Museum and Research Center in Mashantucket brings to life the story of the Mashantucket Pequot tribal nation.

Universities and colleges

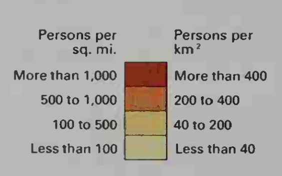
This table lists the universities and colleges in Connecticut that grant bachelor's or advanced degrees and are accredited by the New England Association of Schools and Colleges.

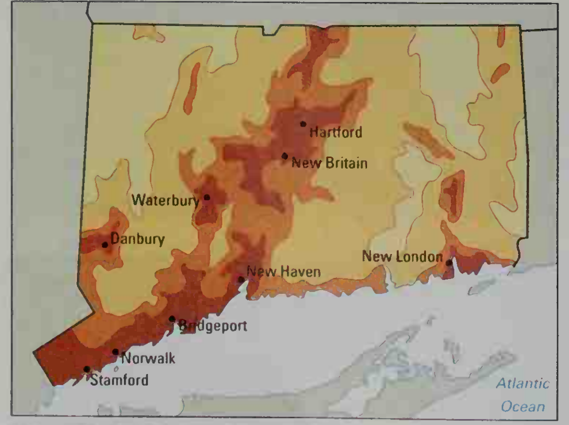
Name	Mailing address
Albertus Magnus College	New Haven
Bridgeport, University of	Bridgeport
Central Connecticut State University	New Britain
Charter Oak State College	New Britain
Connecticut, University of	*
Connecticut College	New London
Eastern Connecticut State University	Willimantic
Fairfield University	Fairfield
Hartford, University of	West Hartford
Hartford Seminary	Hartford
Holy Apostles College and Seminary	Cromwell
New Haven, University of	West Haven
Quinnipiac University	Hamden
Rensselaer at Hartford	Hartford
Sacred Heart University	Fairfield
St. Joseph College	West Hartford
Southern Connecticut State University	New Haven
Teikyo Post University	Waterbury
Trinity College	Hartford
United States Coast Guard Academy	New London
Wesleyan University	Middletown
Western Connecticut State University	Danbury
Yale University	New Haven

*For campuses, see Connecticut, University of.

Population density

Connecticut's most densely populated areas lie chiefly along Long Island Sound and in the center of the state. Eastern and northwestern areas are less populated.





WORLD BOOK map; based on U.S. Census Bureau data.

Connecticut map index

Metropolitan areas

Bridgeport 459,479
Danbury 217,980
Hartford 1,183,110
New Haven-Meriden 542,149
New London-Norwich 293,566 (262,764 in Conn.; 30,802 in R.I.)
Stamford-Norwalk 353,556
Waterbury 228,984
Worcester 511,389 (502,511 in Mass.; 8,878 in Conn.)

Counties

Fairfield 827,645 H 5
Hartford 851,783 C 9
Litchfield 174,092 C 5
Middlesex 143,196 G 10
New Haven 804,219 G 7
New London 254,957 F 13
Tolland 128,699 C 11
Windham 102,525 C 13

Cities, towns, and other populated places

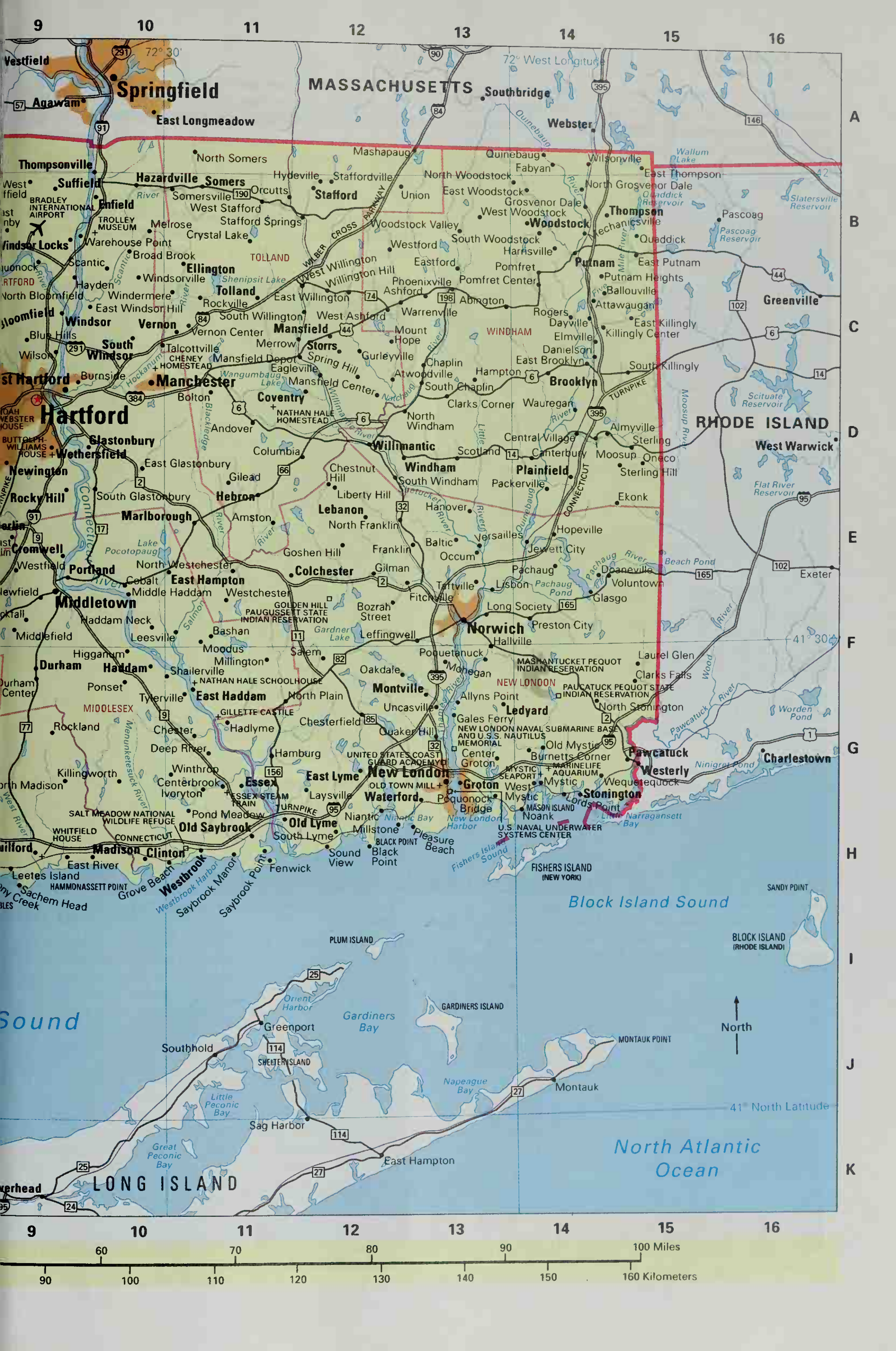
Abington C 13
Almyville D 14
Amesville B 5
Andover▲ 3,036 D 11
Ansonia 18,554 G 6
Ashford▲ 4,098 C 13
Aspetuck I 5
Attawaugan C 14
Atwoodville D 12
Avon▲ 15,832 C 8
Bakersville C 7
Ballouville C 14
Baltic E 13
Bantam 802 D 5
Barkhamsted▲ 3,494 B 7
Bashan F 11
Beacon Falls▲ 5,246 G 7
Berlin▲ 18,215 E 9
Bethany▲ 5,040 G 7
Bethel† 9,137 ▲18,067 G 4
Bethlehem† 2,022 ▲3,422 E 6
Black Point H 12
Bloomfield▲ 19,587 C 9
Blue Hills† 3,020 C 9
Boardman Bridge E 4
Bolton▲ 5,017 D 11
Botsford G 5
Bozrah*▲ 2,357 F 12
Branchville H 4
Branford† 5,735 ▲28,683 H 8
Bridgeport 139,529 I 6
Bridgewater▲ 1,824 F 5
Bristol 60,062 D 7
Broad Brook† 3,469 B 10
Brookfield▲ 15,664 F 4
Brooklyn▲ 7,173 C 14
Bulls Bridge E 4
Burlington▲ 8,190 D 7
Burnetts Corner G 14
Burnside D 9
Campville D 6
Canaan† 1,288 ▲1,081 A 5
Canaan Valley A 5
Candlewood Knolls F 4
Cannondale I 4
Canterbury▲ 4,692 D 14
Canton▲ 8,840 C 8
Canton Center C 7
Canton Valley*† 1,565 C 8
Centerbrook G 11
Central Village D 14
Central Manchester*† 30,595 D 10
Central Somers*† 1,626 B 11
Central Waterford*† 2,935 G 13
Chaplin▲ 2,250 C 13
Cheshire† 5,789 ▲28,543 F 8
Chester† 1,546 ▲3,743 G 11
Chesterfield G 12
Chestnut Hill E 12
Clarks Corner D 13
Clarks Falls F 15
Clinton† 3,516 ▲13,094 H 10
Cobalt E 10
Colchester ▲14,551 E 12
Colebrook▲ 1,471 B 6
Collinsville† 2,686 C 7
Columbia▲ 4,971 D 11
Conning Towers-Nautilus Park*† 10,241 G 13
Cornwall▲ 1,434 C 5
Cornwall Bridge C 4
Coventry▲ 11,504 C 11
Coventry Lake*† 2,914 C 11
Cromwell▲ 12,871 E 9
Crystal Lake† 1,459 B 11
Danbury 74,848 G 4
Danielson 4,265 C 14
Darien† 19,607 ▲19,607 J 4
Dayville C 14
Deep River† 2,470 ▲4,610 G 11
Derby 12,391 H 6
Dodgingtown G 5
Drakeville C 6
Durham† 2,773 ▲6,627 F 9
Durham Center F 9
Eagleville D 12
East Berlin E 9
East Brooklyn† 1,473 C 14
East Canaan B 5
East Glastonbury D 10
East Granby▲ 4,745 B 9
East Haddam▲ 8,333 F 11
East Hampton† 2,254 ▲13,352 E 10
East Hartford▲ 49,575 D 9
East Hartland B 8
East Haven▲ 28,189 H 8
East Killingly C 15
East Litchfield D 6
East Lyme▲ 18,118 G 12
East Plymouth D 7
East River H 9
East Thompson B 15
East Village G 6
East Willington C 12
East Windsor*▲ 9,818 B 10
East Windsor Hill C 10
East Woodstock B 14
Eastford▲ B 13
Easton▲ 7,272 H 5
Ekonk E 14
Ellington▲ 12,921 C 10
Ellsworth C 4
Elmville C 14
Enfield▲ 45,212 B 10
Essex† 2,573 ▲6,505 G 11
Fabyan B 14
Fairfield▲ 57,340 I 5
Falls Village B 5
Farmington▲ 23,641 D 8
Fenwick 52 H 11
Fitchville E 13
Flanders D 4
Franklin▲ 1,835 E 13
Gales Ferry G 13
Gaylordsville E 4
Georgetown† 1,650 H 4
Germantown G 4
Gilead E 11
Gilman E 12
Glasgo F 14
Glastonbury† 7,157 ▲31,876 D 10
Glenville J 3
Golden Hill Paugussett State Indian Reservation F 12
Goshen▲ 2,697 C 5
Goshen Hill E 12
Granby▲ 10,347 B 8
Green Farms J 5
Greenwich▲ 61,101 J 3
Greystone E 7
Griswold*▲ 10,807 E 14
Grosvenor Dale B 14
Groton 10,010 ▲39,907 G 13
Grove Beach H 10
Guilford† 2,603 ▲21,398 H 9
Gurleyville C 12
Haddam▲ 7,157 F 10
Haddam Neck F 10
Hadlyme G 11
Hallville F 13
Hamburg G 11
Hamden▲ 56,913 G 8
Hampton▲ 1,758 D 13
Hanover E 13
Harrisville B 14
Hartford 121,578 D 9
Hartland▲ 2,012 B 7
Harwinton▲ 5,283 D 7
Hawleyville G 5
Hayden C 9
Hazardville† 4,900 B 10
Hebron▲ 8,610 E 11
Heritage Village*† 3,435 F 5
Higganum† 1,671 F 10
Hopeville E 14
Hoskins C 8
Hotchkissville E 6
Huntingtown G 5
Huntsville B 5
Hydeville B 12
Indian Neck H 8
Ivoryton G 11
Jewett City 3,053 E 14
Kensington† 8,541 E 8
Kent▲ 2,858 D 4
Kent Furnace D 4
Killingly*▲ 16,472 C 14
Killingly Center C 14
Killingworth▲ 6,018 G 10
Lake Pocotopaug*† 3,169 E 10
Lakeside D 5
Lakeville B 4
Laurel Glen F 15
Laysville G 12
Lebanon▲ 6,907 E 12
Ledyard▲ 14,687 G 13
Leesville F 10
Leetes Island H 9
Leffingwell F 13
Liberty Hill E 12
Lime Rock B 4
Lisbon▲ 4,069 E 13
Litchfield 1,328 ▲8,316 D 6
Long Ridge J 3
Long Society F 13
Lords Point G 14
Lyme*▲ 2,016 G 11
Lyons Plain I 5
Macedonia D 4
Madison† 2,222 ▲17,858 H 10
Manchester▲ 54,740 D 10
Mansfield▲ 20,720 C 12
Mansfield Depot C 11
Marble Dale E 5
Marion E 7
Marlborough▲ 5,709 E 10
Mashantucket Pequot Indian Res. 315 F 14
Mashapaug A 13
Mechanicsville B 14
Melrose B 10
Meriden 58,244 F 8
Merrow C 11
Middle Haddam F 10
Middlebury▲ 6,451 F 6
Middlefield▲ 4,203 F 9
Middletown 43,167 F 9
Milford 50,594 ▲52,305 I 7
Mill Plain I 5
Milldale E 8
Millington F 11
Millstone H 12
Milton D 5
Minortown E 6
Mixville F 7
Mohegan F 13
Monroe▲ 19,247 H 6
Montville▲ 18,546 F 13
Moodus† 1,263 F 11
Moosup† 3,237 D 14
Morris▲ 2,301 D 6
Mystic† 4,001 G 14
Naugatuck 30,989 F 7
Nautilus Park, see Conning Towers-Nautilus Park
Nepaug C 7
New Britain 71,538 E 8
New Canaan▲ 19,395 I 4
New Fairfield▲ 13,953 F 4
New Hartford† 1,049 ▲6,088 C 7
New Haven 123,626 H 7
New London 25,671 G 13
New Milford† 6,633 ▲27,121 E 4
New Preston† 1,110 E 5
Newfield C 6
Newfield F 9
Newington▲ 29,306 D 9
Newtown 1,843 ▲25,031 G 5
Niantic† 3,085 H 12
Noank† 1,830 H 14
Norfolk▲ 1,660 B 6
Noroton J 4
Noroton Heights J 4
North Branford▲ 13,906 H 8
North Canaan*▲ 3,350 A 5
North Franklin E 12
North Granby† 1,720 B 8
North Grosvenor Dale† 1,424 B 14
North Haven▲ 23,035 G 8
North Plain G 11
North Somers A 11
North Stamford J 3
North Stonington▲ 4,991 G 14
North Westchester E 11
North Windham D 13
North Woodbury F 6
North Woodstock B 13
Northfield D 6
Northford G 8
Northwest Harwinton*† 3,242 D 7
Northville E 4
Norwalk 82,951 I 4
Norwich 36,117 F 13
Oakdale F 12
Oakville† 8,618 E 6
Occum E 13
Old Lyme▲ 7,406 H 11
Old Mystic† 3,205 G 14
Old Saybrook† 1,962 ▲10,367 H 11
Oneco D 15
Orange†▲ 13,233 H 7
Orcutts B 11
Oxford▲ 9,821 G 6
Packerville E 14
Palmers Hill J 3
Park Lane E 4
Paucatuck Pequot State Ind. Res. 26 G 14
Pawcatuck† 5,474 G 15
Pequabuck E 7
Phoenixville C 13
Pine Meadow C 7
Pine Orchard H 8
Plainfield† 2,638 ▲14,619 D 14
Plainville▲ 17,328 E 8
Plantsville E 8
Plattsville H 5
Pleasant Valley B 7
Pleasure Beach H 13
Plymouth▲ 11,634 E 7
Pomfret▲ 3,798 B 14
Pomfret Center C 14
Pond Meadow H 10
Ponset F 10
Poquetanuck F 13
Poquonock 1,592 C 9
Poquonock Bridge† G 13
Portland† 5,534 ▲8,732 E 9
Preston*▲ 4,688 F 14
Preston City F 14
Prospect▲ 8,707 F 7
Putnam† 6,746 ▲9,002 B 14
Putnam Heights C 14
Quaddick B 15
Quaker Farms G 6
Quaker Hill G 13
Quinebaug† 1,122 A 14
Redding▲ 8,270 H 4
Redding Ridge H 5
Reynolds Bridge E 6
Ridgebury G 3
Ridgefield† 7,212 ▲23,643 H 4
Riverbank J 3
Riversville J 2
Riverton B 7
Robertsville B 7
Rockfall F 9
Rockland G 9
Rockville† 7,708 C 11
Rocky Hill▲ 17,966 E 9
Rogers C 14
Round Hill J 3
Rowayton J 4
Roxbury▲ 2,136 F 5
Roxbury Falls F 5
Sachem Head H 9
Salem▲ 3,858 F 12
Salisbury▲ 3,977 B 4
Salmon Brook*† 2,453 B 8
Sandy Hook G 5
Saugatuck I 4
Saybrook Manor† 1,133 H 11
Saybrook Point H 11
Scantic C 10
Schaghticoke State Indian Res. 9 D 4
Scotland▲ 1,556 D 13
Seymour▲ 15,454 G 6
Shailerville F 10
Sharon▲ 2,968 C 4
Sharon Valley C 4
Shelton 38,101 H 6
Sherman▲ 3,827 E 4
Sherwood Manor*† 5,689 B 10
Short Beach H 8
Simsbury† 5,603 ▲23,234 C 8
Somers ▲10,417 B 11
Somersville B 10
Sound View H 12
South Britain F 5
South Canaan B 5
South Chaplin D 13
South Coventry*† 1,381 D 12
South Glastonbury E 10
South Kent D 4
South Killingly C 15
South Lyme H 12
South Willington C 11
South Windham† 1,278 D 12
South Windsor ▲24,412 C 9
South Woodstock† 1,211 B 14
Southbury▲ F 6
Southington▲ 39,728 E 8
Southport I 5
Southwood Acres*† 8,067 B 10
Sprague*▲ 2,971 E 13
Spring Hill D 12
Stafford▲ 11,307 B 12
Stafford Springs B 11
Staffordville B 12
Stamford 117,083 J 3
Stanwich J 3
Sterling ▲3,099 D 15
Stevenson G 6
Stonington 1,032 ▲17,906 G 14
Stony Creek H 9
Storrs† 10,996 C 12
Stratford▲ 49,976 I 6
Suffield▲ 13,552 B 9
Suffield Depot*† 1,244 B 9
Taconic A 4
Taftville 1,371 E 13
Talcottville C 10
Tariffville† B 8
Terramuggus*† 1,048 E 10
Thomaston▲ 7,503 E 6
Thompson▲ 8,878 B 14
Thompsonville† 8,125 B 10
Titicus H 4
Tolland▲ 13,146 C 11
Torrington 35,202 C 6
Trumbull† 34,243 ▲34,243 H 6
Twin Lakes B 4
Uncasville G 13
Uncasville-Oxoboro*† G 13
Union▲ 693 B 12
Unionville D 8
Vernon▲ 28,063 C 10
Vernon Center C 10
Versailles E 13
Voluntown▲ 2,528 E 14
Wallingford† 17,509 ▲43,026 F 8
Warren▲ 1,254 D 5
Warrenville C 12
Washington▲ 3,596 E 5
Washington Depot E 5
Waterbury 107,271 F 7
Waterford▲ 19,152 G 13
Watertown▲ 21,661 E 6
Wauregan† 1,085 D 14
Weatogue† 2,805 C 8
Wequetequock G 14
West Cornwall C 5
West Goshen C 5
West Granby B 8
West Hartford▲ 63,589 D 8
West Hartland B 7
West Haven 52,360 H 7
West Mystic† G 14
West Redding H 4
West Simsbury† 2,395 C 8
West Stafford B 11
West Suffield B 9
West Willington C 12
West Woodstock B 13
Westbrook† 2,238 ▲6,292 H 11
Westchester F 11
Westfield E 9
Westford B 12
Weston▲ 10,037 I 4
Westport▲ 25,749 I 5
Wethersfield▲ 26,271 D 9
Whigville D 7
White Oaks F 6
Willimantic 15,823 D 12
Willington*▲ 5,959 C 12
Willington Hill C 12
Wilson C 9
Wilsonville A 14
Wilton▲ 17,633 I 4
Winchester Center▲ 10,664 C 6
Windermere C 10
Windham▲ 22,857 D 12
Windsor▲ 28,237 C 9
Windsor Locks ▲12,043 B 9
Windsorville C 10
Winsted† 7,321 B 7
Winthrop G 10
Wolcott▲ 15,215 F 7
Woodbridge▲ 8,983 G 7
Woodbury† 1,298 ▲9,198 F 6
Woodmont 1,711 H 7
Woodstock▲ 7,221 B 14
Woodstock Valley B 13
Woodtick E 7
Woodville D 50

*Does not appear on map; key shows general location.
†Census designated place—unincorporated, but recognized as a significant settled community by the U.S. Census Bureau.

▲Population is for entire town (township) including rural areas.
Places without population figures are unincorporated areas.
Source: 2000 census.



Connecticut political map
Urban area
Indian reservation
State boundary
County boundary
NEW HAVEN County name
State capital
City or town
Military or other federal area
Point of interest
Major airport
Railroad
Highways:
Expressway
Other road
Interstate
U.S.
Other
Polyconic projection
WORLD BOOK map
MASSACHUSETTS
NEW YORK
NEW JERSEY
Long Island
LITCHFIELD
FAIRFIELD
NEW HAVEN
Sheffield
Cobble Mountain Reservoir
Taconic
Twin Lakes
Canaan
Canaan Valley
East Canaan
West Hartland
Hartland
East Hartland
North Granby
Granby
Salisbury
Lakeville
Amesville
Norfolk
Colebrook
Robertsville
Riverton
Barkhamsted Reservoir
West Granby
Barkhamsted
Falls Village
South Canaan
Huntsville
Millerton
Lime Rock
South Norfolk
Winsted
Pleasant Valley
Tariffville
Cornwall Hollow
Winchester Center
New Hartford
North Canton
Hoskins
Sharon Valley
Sharon
West Cornwall
Cornwall Center
Cornwall
Newfield
Drakeville
Pine Meadow
Canton Center
West Simsbury
Simsbury
Weatogue
Bakersville
Canton
Avon
Collinsville
Ellsworth
Cornwall Bridge
West Goshen
Goshen
Torrington
Nepaug
Nepaug Reservoir
Macedonia
Milton
Harwinton
Burlington
Unionville
Flanders
Kent Furnace
Kent
Warren
Litchfield
East Litchfield
Bantam
Campville
Bantam Lake
Whigville
Farmington
STANLEY-WHITMAN HOUSE
SCHAGHTICOKE STATE INDIAN RESERVATION
Waramaug Lake
Woodville
East Morris
Morris
Northfield
Terryville
East Plymouth
New Britain
South Kent
New Preston
Lakeside
Thomaston
Bulls Bridge
Marble Dale
Reynolds Bridge
Plymouth
Bristol
Plainville
AMERICAN CLOCK AND WATCH MUSEUM
Gaylordsville
Northville
Washington Depot
Bethlehem
Washington
Hancock
Kensington
Southington
Park Lane
Watertown
Greystone
Boardman Bridge
Sherman
New Milford
Judds Bridge
Oakville
Wolcott
Plantsville
Milldale
Hotchkissville
Minortown
Woodtick
Marion
North Woodbury
Roxbury
Woodbury
Waterbury
Meriden
GLEBE HOUSE
Bridgewater
Middlebury
Bradleyville
Mixville
Beacon
Lake Candlewood
Roxbury Falls
White Oaks
Prospect
Candlewood Knolls
Brookfield
Southbury
Naugatuck
Cheshire
New Fairfield
Brookfield Center
South Britain
Southford
Brooksvale
Oxford
Beacon Falls
Wallingford
Hawleyville
Quaker Farms
DICKERMAN HOUSE
Germantown
Sandy Hook
Bethany
West Point
Danbury
Newtown
Stevenson
Hamden
Northford
Dodgingtown
Seymour
North Haven
Botsford
Augerville
Bethel
Huntingtown
East Village
Ansonia
Lake Gaillard
Ridgebury
Hattertown
Monroe
Derby
Woodbridge
Totoket
Titicus Reservoir
West Redding
Redding Ridge
MANSFIELD HOUSE
North Branford
Shelton
Redding
YALE UNIVERSITY
New Haven
Peekskill
Titicus
Allington
Orange
East Haven
Cross River Reservoir
Ridgefield
Branchville
Easton Reservoir
GOLDEN HILL PAUGUSSETT STATE INDIAN RESERVATION
West Haven
TROLLEY MUSEUM
Branford
New Croton Reservoir
Georgetown
Easton
Trumbull
Short Beach
WEIR FARM NATIONAL HISTORIC SITE
Saugatuck Reservoir
Lyons Plain
Plattsville
New Haven Harbor
Indian Neck
Cannondale
Aspetuck
Woodmont
Pine Orchard
Mount Kisco
North Wilton
Weston
Stratford
Milford
POND POINT
Wilton
Ossining
Bridgeport
SHAKESPEARE THEATER
South Wilton
Mill Plain
JUDSON HOUSE
Long Ridge
New Canaan
Southport
Westport
STRATFORD POINT
North Stamford
Fairfield
Stanwich
PINE CREEK POINT
Norwalk
North Greenwich
Riverbank
Saugatuck
Greens Farms
Darien
Round Hill
Noroton Heights
MARITIME CENTER
Tarrytown
Riverside
Stamford
NORWALK ISLANDS
Rowayton
Palmers Hill
Noroton
White Plains
Glenville
PUTNAM COTTAGE
Greenwich
SHIPPAN POINT
Port Chester
OLD FIELD POINT
EATONS NECK POINT
Miller Place
Rocky Point
Mamaroneck
LLOYD POINT
Huntington Bay
Yonkers
PENINGO NECK
Stony Brook
Cold Spring Harbor
Smithtown Bay
Tenafly
New Rochelle
Bayville
Northport
Mount Vernon
Housatonic River
Naugatuck River
Farmington River
Mad River
Blackberry River
Hudson River
Croton River
Kensico Reservoir
Lake De Forest
West Branch Reservoir
MERRITT PARKWAY
CONNECTICUT TURNPIKE
TACONIC STATE PARKWAY
0 5 10 15 20 25 30 35 40 45 50
0 5 10 15 20 25 30 35 45 50 60 70 80



9
10
11
12
13
14
15
16
MASSACHUSETTS
Springfield
Westfield
Agawam
East Longmeadow
Southbridge
Webster
72° 30'
72° West Longitude
A
B
C
D
E
F
G
H
I
J
K
Thompsonville
Suffield
Hazardville
Somers
North Somers
Somersville
Orcutts
Hydeville
Staffordville
Stafford
Mashapaug
Union
West Stafford
Stafford Springs
Crystal Lake
BRADLEY INTERNATIONAL AIRPORT
Enfield
TROLLEY MUSEUM
Melrose
Warehouse Point
Windsor Locks
Broad Brook
Scantic
Ellington
TOLLAND
Windsorville
Hayden
Windermere
Shenipsit Lake
Tolland
North Bloomfield
East Windsor Hill
Rockville
Bloomfield
Windsor
Vernon
South Willington
Vernon Center
Blue Hills
South Windsor
Talcottville
Wilson
CHENEY HOMESTEAD
Mansfield Depot
Burnside
Manchester
Wangumbaug Lake
East Hartford
Hartford
Bolton
Coventry
NATHAN HALE HOMESTEAD
Andover
BUTTOLPH-WILLIAMS HOUSE
Glastonbury
Wethersfield
Columbia
East Glastonbury
Newington
Gilead
Rocky Hill
South Glastonbury
Hebron
Marlborough
Amston
Cromwell
Lake Pocotopaug
Westfield
Portland
North Westchester
Cobalt
East Hampton
Middle Haddam
Westchester
Middletown
Haddam Neck
Middlefield
Leesville
Bashan
Moodus
Higganum
Durham
Haddam
Millington
Shailerville
NATHAN HALE SCHOOLHOUSE
Durham Center
Ponset
Tylerville
East Haddam
MIDDLESEX
GILLETTE CASTLE
Rockland
Chester
Hadlyme
Deep River
Killingworth
Winthrop
Centerbrook
North Madison
Ivoryton
Essex
ESSEX STEAM TRAIN
SALT MEADOW NATIONAL WILDLIFE REFUGE
Pond Meadow
WHITFIELD HOUSE
Old Saybrook
CONNECTICUT
Guilford
Madison
Clinton
East River
Leetes Island
HAMMONASSETT POINT
Sachem Head
Grove Beach
Westbrook
Westbrook Harbor
Saybrook Manor
Saybrook Point
Fenwick
CROSS PARKWAY
WILBUR
West Willington
Willington Hill
East Willington
Mansfield
Merrow
Storrs
Spring Hill
Gurleyville
Eagleville
Mansfield Center
South Ashford
Ashford
Phoenixville
Westford
Eastford
Woodstock Valley
Warrenville
Mount Hope
Chaplin
Atwoodville
South Chaplin
Hampton
Abington
North Windham
Willimantic
Windham
South Windham
Chestnut Hill
Liberty Hill
Lebanon
North Franklin
Goshen Hill
Franklin
Colchester
Gilman
GOLDEN HILL PAUGUSSETT STATE INDIAN RESERVATION
Bozrah Street
Gardner Lake
Leffingwell
Salem
Oakdale
Montville
North Plain
Uncasville
Chesterfield
Quaker Hill
Hamburg
UNITED STATES COAST GUARD ACADEMY
East Lyme
New London
Laysville
OLD TOWN MILL
Waterford
Old Lyme
Niantic
Niantic Bay
Millstone
South Lyme
BLACK POINT
Black Point
Pleasure Beach
Sound View
Quinebaug
Fabyan
North Woodstock
East Woodstock
Grosvenor Dale
West Woodstock
Woodstock
South Woodstock
Harrisville
Pomfret
Pomfret Center
WINDHAM
Rogers
Dayville
Elmville
Danielson
East Brooklyn
Brooklyn
Clarks Corner
Wauregan
Central Village
Scotland
Canterbury
Plainfield
Packerville
Hanover
Baltic
Versailles
Occum
Jewett City
Hopeville
Pachaug
Taftville
Fitchville
Lisbon
Long Society
Norwich
Hallville
Preston City
Poquetanuck
Mohegan
MASHANTUCKET PEQUOT INDIAN RESERVATION
NEW LONDON
PAUCATUCK PEQUOT STATE INDIAN RESERVATION
Allyns Point
Ledyard
Gales Ferry
NEW LONDON NAVAL SUBMARINE BASE AND U.S.S. NAUTILUS MEMORIAL
Center Groton
Groton
MYSTIC SEAPORT
MARINELIFE AQUARIUM
Old Mystic
Burnetts Corner
Mystic
West Mystic
Poquonock Bridge
New London Harbor
Noank
MASON ISLAND
Stonington
Lords Point
U.S. NAVAL UNDERWATER SYSTEMS CENTER
Fishers Island Sound
FISHERS ISLAND (NEW YORK)
Wilsonville
North Grosvenor Dale
Quaddick Reservoir
Thompson
Mechanicsville
Quaddick
Putnam
East Putnam
Putnam Heights
Ballouville
Attawaugan
East Killingly
Killingly Center
South Killingly
TURNPIKE
Almyville
Sterling
Moosup
Oneco
Sterling Hill
Ekonk
Beach Pond
Doaneville
Voluntown
Pachaug Pond
Glasgo
Laurel Glen
Clarks Falls
North Stonington
Pawcatuck
Westerly
Wequetequock
Little Narragansett Bay
East Thompson
Wallum Lake
RHODE ISLAND
Pascoag
Pascoag Reservoir
Slatersville Reservoir
Greenville
Scituate Reservoir
West Warwick
Flat River Reservoir
Exeter
41° 30'
Worden Pond
Charlestown
Ninigret Pond
Block Island Sound
SANDY POINT
BLOCK ISLAND (RHODE ISLAND)
PLUM ISLAND
Orient Harbor
Gardiners Bay
GARDINERS ISLAND
Greenport
Southold
SHELTER ISLAND
MONTAUK POINT
Montauk
Napeague Bay
Little Peconic Bay
Sag Harbor
Great Peconic Bay
East Hampton
LONG ISLAND
Riverhead
Sound
North
41° North Latitude
North Atlantic Ocean
60
70
80
90
100 Miles
90
100
110
120
130
140
150
160 Kilometers

Visitor's guide

Southern Connecticut's seashore offers vacationers swimming, fishing, boating, and beautiful scenery. Inland, many summertime visitors hike and ride horseback across the state's wooded hills and valleys. Many people fish in Connecticut's rivers, streams, and lakes. Camping is a popular activity in both private campgrounds and state parks and forests. During winter, the state's snow-covered hills provide skiing and other winter sports. Tourists and students of American history also may visit many historic sites, museums, and colonial buildings in cities and towns throughout the state.

One of the best-known annual events in Connecticut is the Dogwood Festival held in Fairfield in May. Visitors to the festival enjoy the beautiful dogwood trees that bloom in the city and tours of scenic gardens and historic houses. Country fairs are held in various Connecticut towns from early August to mid-October. During the winter, Connecticut's history is brought to life by sleigh rides through the countryside, antique shows and craft shows, and special holiday festivities.



Roy Gumpel, De Wys, Inc.

The blessing of the fleet is a colorful ceremony held each year in Stonington. It arose from an old Portuguese Catholic tradition of blessing fishing fleets before they set sail.



© Steve Dunwell

The Mashantucket Pequot Museum and Research Center has *dioramas* (scenic representations) of the daily lives of the Indians who first lived in the Connecticut area.

Places to visit

Following are brief descriptions of some of Connecticut's many interesting places to visit:

Colonial buildings are among Connecticut's most famous landmarks. Almost every Connecticut town has at least one example of Colonial architecture. *Whitfield House,* in Guilford, is the oldest house in the state. It was begun in 1639, and is the oldest stone house in New England. Three buildings stand as shrines to Nathan Hale, the famous Connecticut patriot. *Nathan Hale Homestead* in South Coventry was the home of Hale's parents. In East Haddam and New London are the *Nathan Hale Schoolhouses,* where Hale taught school from 1773 to 1775. Other Connecticut colonial buildings, with the location and original completion date of each, include *Putnam Cottage* (Greenwich, about 1690); *Buttolph-Williams House* (Wethersfield, 1710); *Noah Webster House* (West Hartford, 1748); *Glebe House* (Woodbury, 1750?); *Webb House* (Wethersfield, 1752); *Cheney Homestead* (Manchester, 1785?); and *Old State House* (Hartford, 1796).

Essex Steam Train, at Essex Junction, offers a scenic 16-mile (26-kilometer) round trip through the lower Connecticut River Valley. Passenger cars are drawn by a steam locomotive dating from the early 1900's.

The Maritime Center at Norwalk explores the maritime culture and marine life of Long Island Sound. The center's features include more than 20 aquariums, a maritime history hall with exhibits, an IMAX movie theater, and boat-building demonstrations and workshops.

Mark Twain House, in Hartford, was the home of the famous American author during the late 1800's. The residence has many original furnishings and other personal belongings of Twain's family. A cottage nearby was the home of American author Harriet Beecher Stowe during the late 1800's.

Mashantucket Pequot Museum and Research Center, in Mashantucket, includes exhibits on the Mashantucket Pequot and other tribes and the natural history of southern New England. Visitors can tour a re-creation of a Pequot village from the 1500's.

Mystic Aquarium, in Mystic, contains more than 3,500 specimens of marine life. Exhibits include an indoor theater that features demonstrations with dolphins, sea lions, and whales, and an outdoor exhibit of seals, sea lions, and penguins.

Mystic Seaport, in Mystic, recalls Connecticut's seafaring tradition. The seaport has been rebuilt to look like a whaling village of the 1800's. The *Charles W. Morgan,* New England's last wooden whaling ship, is in the harbor.

Trolley museums exhibit trolleys that date from the late 1800's and early 1900's. Visitors may ride on some of the trolleys. The museums are the Shore Line Trolley Museum in East Haven, and the Connecticut Trolley Museum in East Windsor.

U.S.S. *Nautilus* Memorial, in Groton, honors the *Nautilus,* the world's first nuclear-powered submarine and the first submarine to reach the North Pole. Visitors can explore the submarine's control room, handle working periscopes, and view films on naval history.

State parks and forests. Connecticut has 92 state parks and 30 state forests. For information, write to State Department of Environmental Protection, 79 Elm Street, Hartford, CT 06106.

Annual events

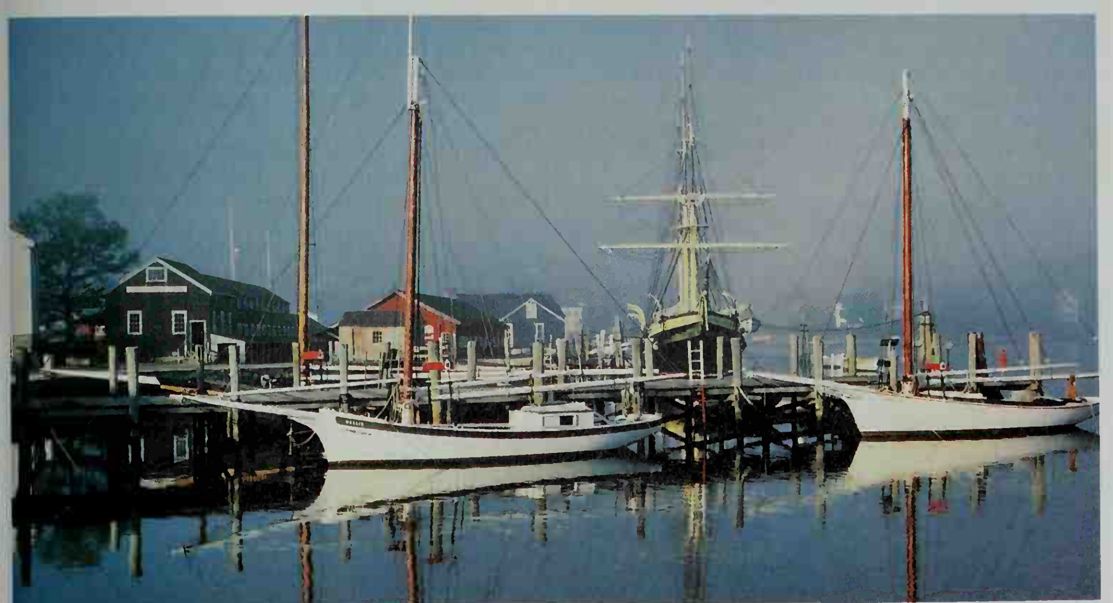
January-June
Connecticut Flower and Garden Show in Hartford (February); Daffodil Festival in Meriden (April); Garlicfest in Fairfield (May); Dogwood Festival in Fairfield (May); Lobsterfest in Mystic (May); Farmington Antiques Weekend in Farmington (June); International Festival of Arts and Ideas in New Haven (June); Canon Greater Hartford Open in Cromwell (June).

July-December
Blessing of the Fleet in Stonington (July); Riverfest in Hartford and East Hartford (July); Connecticut Jazz Festival in Guilford (August); Pilot Pen Tennis Women's Tournament in New Haven (August); Mystic Outdoor Arts Festival in Mystic (August); Farmington Antiques Weekend in Farmington (August or September); Norwalk Oyster Festival in Norwalk (September); Apple Harvest Festival in Southington (September); Manchester Road Race in Manchester (November); First Night Hartford in Hartford (December).



Connecticut Department of Economic & Community Development

The Shore Line Trolley Museum in East Haven



© Tom Algire

Mystic Seaport in Mystic



Connecticut Department of Economic & Community Development

Mark Twain House in Hartford



© John Muldoon, Connecticut Department of Economic & Community Development

Farmington Antiques Weekend in Farmington

Land and climate

Land regions. Connecticut has five main land regions: (1) the Taconic Section, (2) the Western New England Upland, (3) the Connecticut Valley Lowland, (4) the Eastern New England Upland, and (5) the Coastal Lowlands.

The Taconic Section covers the northwestern corner of Connecticut between the Housatonic River and the New York border. This region also extends north into Massachusetts. The Taconic Section includes the highest point in Connecticut, on the south slope of Mount Frissell.

The Western New England Upland occupies most of western Connecticut, and parts of Massachusetts and Vermont. In Connecticut, it lies from 1,000 to 1,400 feet (300 to 427 meters) above sea level. The land slopes from northwest to southeast. Many rivers flow between the region's ridges and steep hills.

The Connecticut Valley Lowland extends through the center of Connecticut and north into Massachusetts. It averages 20 miles (32 kilometers) in width. Basalt ridges, including Hanging Hills, Mount Lamentation, and Talcott Mountain, rise from 300 to 600 feet (91 to 180 meters) above the valley.

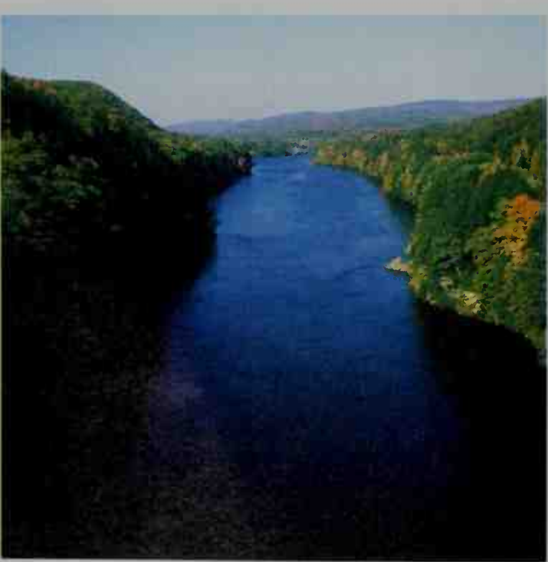
The Eastern New England Upland covers most of eastern Connecticut. The entire upland stretches from Connecticut to Maine. In Connecticut, it is heavily forested and has narrow river valleys and low hills. Few of the hills rise as high as 1,200 feet (366 meters). The land slopes gradually from northwest to southeast.

The Coastal Lowlands are part of a larger region of the same name that covers the New England coast. In Connecticut, the region is a narrow belt, from 6 to 16 miles (10 to 26 kilometers) wide, along the southern shore. The coastal lowlands are somewhat lower and more level than the rest of the state's regions. The lowlands are broken by low ridges and by beaches and harbors along the coast.

Coastline. Connecticut's 618-mile (995-kilometer) shoreline includes bays and mouths of many rivers. The Connecticut shore has many fine harbors, including Greenwich, Stamford, Norwalk, Bridgeport, New Haven, and New London. Long Island, a part of New York that lies south of Connecticut, helps protect Connecticut's shore from Atlantic storms.

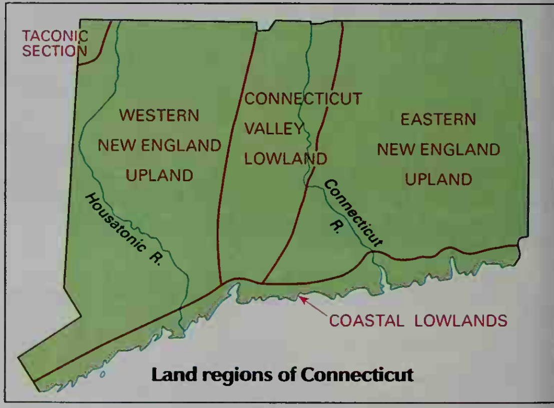
Several small islands lie off the Connecticut coast. The largest, Mason Island, covers about 1 $\frac{1}{2}$ square miles (3.9 square kilometers) near Mystic. Other islands include the Norwalk Islands off Norwalk and The Thimbles near Branford.

Mountains. Connecticut's highest places are all in northwestern Litchfield County. The highest point in the state, which lies on the south slope of Mount Frissell, has an altitude of 2,380 feet (725 meters). The top of Mount Frissell is in Massachusetts. Other mountains include Bear Mountain (2,355 feet, or 718 meters), Mount Gridley (2,200 feet, or 671 meters), Mount Riga (2,000 feet, or 610 meters), and Bradford Mountain (1,962 feet, or 598 meters).



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The Connecticut River flows south through central Connecticut and empties into Long Island Sound. Some oceangoing ships can navigate the river up to 50 miles (80 kilometers) inland.



WORLD BOOK map

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Specially created for *The World Book Encyclopedia* by Rand McNally and World Book editors

Rivers, waterfalls, and lakes. The Connecticut River flows south through the center of the state. It is Connecticut's chief river. Some ocean-going ships can navigate on the Connecticut as far north as Hartford, 50 miles (80 kilometers) inland. The Housatonic River and its chief tributaries, the Naugatuck and Shepaug rivers, drain the Western New England Upland. The Thames and the Quinebaug are the chief rivers of eastern Connecticut. The state has many small waterfalls. Kent Falls, the largest, plunges about 200 feet (61 meters) along a distance of about $\frac{1}{4}$ mile (0.4 kilometer) near Kent.

Over 1,000 lakes dot the landscape. Most are small lakes that were formed by glaciers thousands of years ago. Several of the largest ones are used as reservoirs. Others provide recreational activities. The largest lake, Lake Candlewood, was created artificially to store water for generating power. Other lakes include Bantam, Pachaug, Shenipsit, Twin Lakes, and Waramaug.

Plant and animal life. Forests cover more than 60 percent of Connecticut. Trees include ash, beech, birch, elm, hemlock, hickory, maple, oak, and pine.

Average monthly weather

	Hartford					Bridgeport				
	Temperatures F°		Temperatures C°		Days of rain or snow	Temperatures F°		Temperatures C°		Days of rain or snow
	High	Low	High	Low		High	Low	High	Low	
Jan.	36	18	2	−8	13	37	22	3	−6	12
Feb.	38	18	3	−8	11	37	21	3	−6	10
Mar.	47	27	8	−3	12	45	29	7	−2	12
Apr.	60	36	16	2	12	55	37	13	3	13
May	72	47	22	8	12	67	48	19	9	11
June	81	57	27	14	10	76	58	24	14	7
July	86	62	30	17	10	82	64	28	18	9
Aug.	83	60	28	16	10	80	63	27	17	10
Sept.	76	52	24	11	9	74	56	23	13	9
Oct.	65	41	18	5	8	64	45	18	7	7
Nov.	51	31	11	−1	10	52	35	11	2	9
Dec.	39	20	4	−7	11	40	25	4	−4	10

The mountain laurel, Connecticut's state flower, grows throughout the woodlands and along roads. Many people in western Connecticut call this evergreen flowering shrub *ivy.* Dogwood grows throughout the state. Bayberry, sheep laurel, and sweet fern cover many fields in the state.

Connecticut's animal life consists chiefly of small creatures, though the population of white-tailed deer increased significantly in the late 1900's. Animals prized by hunters and trappers include foxes, hares, minks, muskrats, otters, and rabbits. Freshwater ducks are the most common game birds. Partridges, ring-necked pheasants, and ruffed grouse are also hunted. Orioles, sparrows, thrushes, and warblers live in the state.

Connecticut waters in Long Island Sound have many clams, menhaden, lobsters, and oysters. Shad is the leading fish of the state's inland waterways. Trout and other game fish are plentiful in the lakes and streams.

Climate. Connecticut's weather is rarely very cold or very hot. January temperatures average 26 °F (−3 °C), and July temperatures average 71 °F (22 °C). The state's record low, −32 °F (−36 °C), was set in Falls Village on Feb. 16, 1943. The record high temperature, 106 °F (41 °C), was set in Danbury on July 15, 1995.

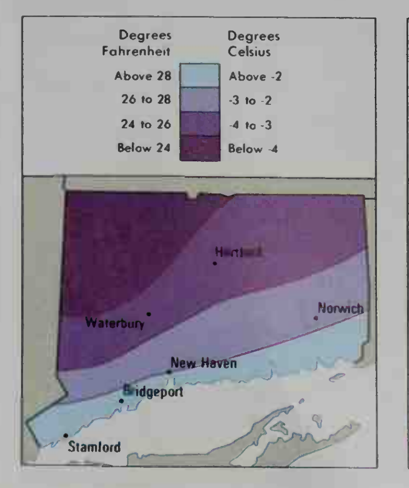
Although Connecticut is a small state, its climate and weather can vary greatly from one area to another. The same storms that deposit large amounts of snow in the hills of the northern part of the state may produce only light rain on the coast, less than 50 miles (80 kilometers) away.

Yearly precipitation in Connecticut averages about 47 inches (119 centimeters). The average amount of yearly rainfall is distributed fairly evenly throughout the state.

Snowfall averages from about 25 inches (64 centimeters) yearly in the southeast part of Connecticut to about 35 inches (89 centimeters) in the western and central parts. The highest elevations in northwest Connecticut sometimes receive 80 inches (200 centimeters) of snow annually.

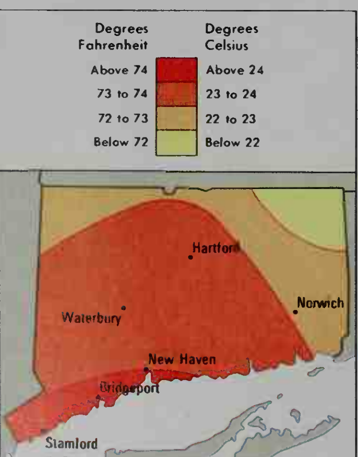
Average January temperatures

In winter, the state's temperatures are coldest throughout the northwest. The mildest areas lie along the Atlantic coast.



Average July temperatures

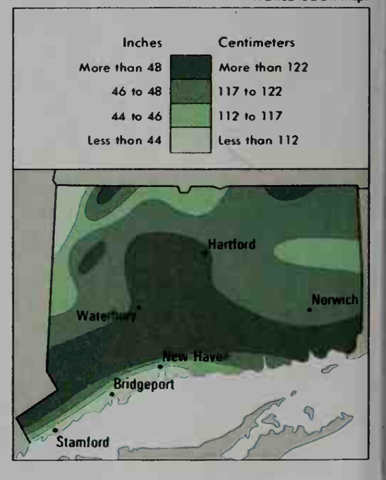
In summer, temperatures are generally even throughout the state. The warmest area is the southwestern coast.



Average yearly precipitation

The state gets a fairly even amount of rainfall. The heaviest snow falls in the western and central sections.





Service industries, taken together, make up the greatest portion of Connecticut's *gross state product*—the total value of all goods and services produced in a state in a year. However, manufacturing continues to be a very important economic activity. Manufacturing is centered in Fairfield, Hartford, and New Haven counties. Military vehicles and machine tools are among the state's most valuable manufactured products.

Finance, insurance, and real estate combine to form Connecticut's leading service industry. The Hartford area has a number of the nation's largest insurance companies. Many corporations have headquarters in the state, particularly in the urban areas near New York City. Trade and tourism thrive in many parts of Connecticut. Tourists flock to the state's many scenic areas and historic sites.

Natural resources. Unlike many of the other states, Connecticut does not depend chiefly on its own natural resources for the raw materials of its industries. The state has many forests, but they are not commercially important. Connecticut lacks large deposits of valuable minerals.

Soil. Soils at low elevations produce good vegetable and tobacco crops, especially along the Connecticut River. Much of the soil in the uplands is stony. It is best suited for growing grass that can be made into hay or growing corn that can be used to feed dairy cattle.

Minerals. Stone—especially a kind of basalt called traprock—and sand and gravel are Connecticut's leading mined products. Clays, feldspar, and mica are also found in the state.

Service industries account for the largest portion of Connecticut's gross state product. Connecticut's service industries are concentrated in the metropolitan areas.

The finance, insurance, and real estate industry contributes more to Connecticut's gross state product than any other industry. The Hartford area is the home of about 50 insurance companies, including 3 of the largest in the United States. Some of the corporations that operate insurance firms also operate investment and real estate companies.

Production and workers by economic activities

Economic activities	Percent of GSP* produced	Employed workers: Number of people	Employed workers: Percent of total
Finance, insurance, & real estate	28	231,400	11
Community, business, & personal services	22	698,300	33
Manufacturing	17	285,600	14
Wholesale and retail trade	14	410,700	20
Government	9	224,800	11
Transportation, communication, & utilities	6	84,000	4
Construction	3	99,000	5
Agriculture	1	31,700	2
Mining	†	1,900	†
Total	100	2,067,400	100

*GSP = gross state product, the total value of goods and services produced in a year.
†Less than one-half of 1 percent.
Figures are for 1998.
Sources: *World Book* estimates based on data from U.S. Bureau of Economic Analysis and U.S. Bureau of Labor Statistics.



Sikorsky Aircraft

Commercial helicopters are produced on an assembly line at a factory in Bridgeport. Connecticut is a leading state in the production of helicopters, jet aircraft engines, and propellers.

Community, business, and personal services rank second among the state's service industries in terms of the gross state product. These services include enterprises such as private health care, engineering and law firms, and computer and data processing services. Tourists spend about $5 billion a year in the state.

Wholesale and retail trade form the third-ranking service industry in Connecticut. New Haven is an important center for the wholesale trade of fuels, lumber, and farm products. Major types of retail trade establishments include automobile dealerships, department stores, food stores, and restaurants.

Government ranks fourth among the state's service industries in terms of the gross state product. Government services include the operation of public schools and hospitals, and military activities. State government offices are centered in Hartford.

Transportation, communication, and utilities rank fifth among the service industries. More information about transportation, communication, and utilities appears later in this section.

Manufacturing. Goods made in Connecticut have a *value added by manufacture* of about $28 billion a year. This figure represents the increase in value of raw materials after they become finished products.

The production of transportation equipment is Connecticut's most important manufacturing activity. Most of the transportation equipment made in the state is for military uses. Connecticut is a leading producer of aircraft parts, helicopters, and submarines. Large factories that make aircraft parts are in East Hartford, Middletown, North Haven, Stratford, and Windsor Locks. Bridgeport produces commercial helicopters, and Stratford makes military helicopters. Groton is a major national center for submarine production.

Economy of Connecticut

This map shows the economic uses of land in Connecticut and where the leading farm and mineral products are produced. Major manufacturing centers are shown in red.



WORLD BOOK map

Fabricated metal products rank second in terms of value added. Connecticut ranks high among the states in the production of cutlery and hardware. Other metal products include bolts, nuts, rivets, washers, and valve and pipe fittings. New Britain and New Haven are important hardware centers.

Chemicals are Connecticut's third most valuable manufactured product. Pharmaceuticals and cleaning products are the leading manufactures in this sector. New Haven and Danbury are leading centers of chemicals production.

Machinery ranks fourth among Connecticut's manufactured products. Leading types of machinery made in the state include bearings, computers, machine tools, and printing machinery. The Bridgeport and Hartford areas manufacture most of Connecticut's machinery.

Other products manufactured in Connecticut include computer and electronic equipment, electrical equipment, food products, and printed materials. Telephone equipment is the state's leading electronic manufacture. The state is also a leading producer of electrical conductors, outlets, and switches.

Agriculture. Farmland covers only a little more than 10 percent of Connecticut's land area. The state has about 3,800 farms.

Greenhouse and nursery products are Connecticut's leading source of agricultural income. These products include ornamental shrubs, flowers, and young plants. Milk and eggs are the next most important farm products. Dairy cattle can be found in Connecticut's rural areas. Most egg farms are in the eastern part of the state.

Tobacco, hay, and corn are the state's leading field crops. Connecticut farmers raise an expensive variety of tobacco that is used to make cigar wrappers. They also raise beef cattle, apples, grapes, and mushrooms.

Mining. Crushed stone is Connecticut's chief mined product. Sand and gravel provide most of the remaining income. All of these products are used mainly to make roadbeds and concrete. Most of the crushed stone is obtained from traprock quarries in New Haven and Hartford counties. Connecticut also mines small amounts of clays, feldspar, and granite.

Fishing industry. The annual fish catch in Connecticut is valued at about $60 million. Shellfish, which include clams, lobsters, oysters, and scallops, provide most of the income. Flounder and shad also provide some of the fishing income. Fish farms are an important component of the state's fishing industry. Oysters and other shellfish are the main products of these farms.

Electric power. Plants that burn petroleum provide about half of Connecticut's electric power. Nuclear power plants generate about 20 percent of the state's electric power. Hydroelectric plants and plants that burn natural gas or coal also provide small amounts of power.

Transportation. Connecticut has about 20,000 miles (32,000 kilometers) of roads and highways. The Connecticut Turnpike crosses the state from the New York border, near Greenwich, to the Rhode Island border, in Killingly.

The Hartford and New Haven, Connecticut's first important railroad, began service between New Haven and Meriden in 1838. Today, a number of railroads in the state provide freight service. Passenger trains serve more than 45 cities and towns in Connecticut. Some of these trains carry thousands of Connecticut commuters to and from their jobs in New York City.

Bradley International Airport in Windsor Locks is Connecticut's major airport. The state's busiest seaports are Bridgeport and New Haven.

Communication. About 110 newspapers, including about 20 dailies, are published in Connecticut. The *Connecticut Courant* (now *The Hartford Courant*) began publication in 1764. It is the oldest continuously published newspaper in the nation. The *Courant,* the *Connecticut Post* of Fairfield County, the *New Haven Register,* and the *Waterbury Republican-American* are among Connecticut's chief newspapers. The state's publishers also produce about 280 periodicals.

Connecticut's first radio station, WDRC, opened in Hartford in 1922. The first television station, WNHC (now WTNH-TV), began operating in New Haven in 1948. Connecticut now has about 80 radio stations and 15 television stations. Cable television systems and Internet providers service communities statewide.

Government

Constitution of Connecticut was adopted in 1965. It replaced an earlier Constitution adopted in 1818. Colonial Connecticut's first constitution was the Fundamental Orders of 1639. Connecticut governed itself under the Fundamental Orders until it received a royal charter in 1662. The charter was the constitution until 1818.

An *amendment* (change) to the Constitution may be proposed by the legislature or by a constitutional convention. An amendment proposed by the legislature must be approved by a majority of the members of each house, and by a majority of electors voting on the amendment in a general election. If the amendment is approved by a three-fourths majority of each house, electors vote on it in the next general election. If it is approved by a majority of less than three-fourths of each house, it must be approved again by a majority in a regular session of the legislature after the next general election held in an even-numbered year. Then it is voted on in a general election.

A constitutional convention may be called by a two-thirds vote in each house of the legislature, or by a majority of electors voting on the question. An amendment proposed by a convention must be approved by a majority of the electors.

Executive. The governor of Connecticut is elected to a four-year term and may be reelected any number of times. The voters also elect the lieutenant governor, attorney general, comptroller, secretary of state, and state treasurer. All of these offices have four-year terms. The governor, with the approval of either house of the legislature, appoints most other top executive officials.

Legislature, called the *General Assembly,* consists of a 36-member Senate and a 151-member House of Representatives. Voters in each of Connecticut's 36 senatorial districts elect one senator. Voters in each of the state's 151 assembly districts elect one representative. Senators and representatives serve two-year terms.

Regular sessions begin on the Wednesday after the first Monday in January in odd-numbered years and on the Wednesday after the first Monday of February in even-numbered years. The sessions must end by the Wednesday after the first Monday in June in odd-numbered years and by the Wednesday after the first Monday in May in even-numbered years. Special sessions have no time limits. They may be called by the governor or by a majority of each house.

In 1965, Connecticut *reapportioned* (redivided) its legislature to provide equal representation based on population. It also provided for reapportionment after each federal census. For a discussion of reapportionment, in

The state governors of Connecticut

	Party	Term
Jonathan Trumbull	None	1776-1784
Matthew Griswold	Federalist	1784-1786
Samuel Huntington	Federalist	1786-1796
Oliver Wolcott	Federalist	1796-1797
Jonathan Trumbull II	Federalist	1797-1809
John Treadwell	Federalist	1809-1811
Roger Griswold	Federalist	1811-1812
John Cotton Smith	Federalist	1812-1817
Oliver Wolcott, Jr.	Jeffersonian Republican	1817-1827
Gideon Tomlinson	Jeffersonian Republican	1827-1831
John S. Peters	National Republican	1831-1833
Henry W. Edwards	Democratic	1833-1834
Samuel A. Foot	Whig	1834-1835
Henry W. Edwards	Democratic	1835-1838
William W. Ellsworth	Whig	1838-1842
Chauncey F. Cleveland	Democratic	1842-1844
Roger S. Baldwin	Whig	1844-1846
Isaac Toucey	Democratic	1846-1847
Clark Bissell	Whig	1847-1849
Joseph Trumbull	Whig	1849-1850
Thomas H. Seymour	Democratic	1850-1853
Charles H. Pond	Democratic	1853-1854
Henry Dutton	Whig	1854-1855
William T. Minor	American*	1855-1857
Alexander H. Holley	American and Republican†	1857-1858
William A. Buckingham	Republican	1858-1866
Joseph R. Hawley	Republican	1866-1867
James E. English	Democratic	1867-1869
Marshall Jewell	Republican	1869-1870
James E. English	Democratic	1870-1871
Marshall Jewell	Republican	1871-1873
Charles R. Ingersoll	Democratic	1873-1877
Richard D. Hubbard	Democratic	1877-1879
Charles B. Andrews	Republican	1879-1881
Hobart B. Bigelow	Republican	1881-1883
Thomas M. Waller	Democratic	1883-1885
Henry B. Harrison	Republican	1885-1887
Phineas C. Lounsbury	Republican	1887-1889
Morgan G. Bulkeley	Republican	1889-1893
Luzon B. Morris	Democratic	1893-1895
O. Vincent Coffin	Republican	1895-1897
Lorrin A. Cooke	Republican	1897-1899
George E. Lounsbury	Republican	1899-1901
George P. McLean	Republican	1901-1903
Abiram Chamberlain	Republican	1903-1905
Henry Roberts	Republican	1905-1907
Rollin S. Woodruff	Republican	1907-1909
George L. Lilley	Republican	1909
Frank B. Weeks	Republican	1909-1911
Simeon E. Baldwin	Democratic	1911-1915
Marcus H. Holcomb	Republican	1915-1921
Everett J. Lake	Republican	1921-1923
Charles A. Templeton	Republican	1923-1925
Hiram Bingham	Republican	1925
John H. Trumbull	Republican	1925-1931
Wilbur L. Cross	Democratic	1931-1939
Raymond E. Baldwin	Republican	1939-1941
Robert A. Hurley	Democratic	1941-1943
Raymond E. Baldwin	Republican	1943-1946
Wilbert Snow	Democratic	1946-1947
James L. McConaughy	Republican	1947-1948
James C. Shannon	Republican	1948-1949
Chester Bowles	Democratic	1949-1951
John Lodge	Republican	1951-1955
Abraham A. Ribicoff	Democratic	1955-1961
John N. Dempsey	Democratic	1961-1971
Thomas J. Meskill	Republican	1971-1975
Ella T. Grasso	Democratic	1975-1980
William A. O'Neill	Democratic	1980-1991
Lowell P. Weicker, Jr.	Independent	1991-1995
John G. Rowland	Republican	1995-

*Sometimes called Know-Nothing.
†Sometimes called Know-Nothing Republican.

the state, see *The mid-1900's* section of this article.

Courts. Connecticut's judicial system consists of the Supreme Court, the highest court in the state; the appellate court; the superior court; and probate courts. The superior court is the only general trial court. There are 7 Supreme Court justices, 11 appellate court judges, and 150 superior court judges. At times, all 168 judges meet together and are considered superior court judges. The justices and judges of the higher courts are nominated by the governor and appointed by the General Assembly to eight-year terms. Connecticut's voters elect the state's 132 probate court judges to four-year terms.

Local government in Connecticut is centered in 169 *towns.* Connecticut towns are similar to *townships* in other states. The towns may include several communities and large rural areas under one government.

Many small Connecticut towns use the town meeting form of government. This pure form of democracy allows citizens to take a direct part in their local government. Each year, town voters meet to elect officials, approve budgets, and decide other business. See **Town meeting.**

Some towns have heavily populated areas called *boroughs* and *cities.* Most of the 9 boroughs have a government that is independent of the town government. In most of the 19 cities, the city and town governments operate as a unit—called a *city government.* The most common city government is the mayor-council type. Some cities use the council-manager form. Connecticut cities operate under state charters. All chartered cities have *home rule*—they are free to amend their own charters. Connecticut and Rhode Island are the only states that do not have county governments. The two states do have geographical areas called counties, however.

Revenue. Taxation provides about two-thirds of the state government's *general revenue* (income). Most of the rest comes from federal grants and programs. General sales and use tax and personal income tax bring in the largest percentage of the state's revenue. Other sources of revenue include a motor fuel tax, a corporate income tax, inheritance taxes, the sale of motor vehicle licenses, an insurance premium tax, a public utility tax, and legalized gambling.

Politics. Connecticut gave early support to the Republican Party after the party was formed in 1854. In presidential elections between 1856 and 1932, Connecticut voted for 15 Republicans and only 5 Democrats. The voters chose about three times as many Republicans as Democrats for governor during the same period. The Democrats gained strength during the 1930's. Since 1960, registered Democratic voters have outnumbered registered Republicans in Connecticut. For Connecticut's electoral votes and voting record in presidential elections, see **Electoral College** (table).

History

Early days. The Indians who lived in what is now Connecticut before the Europeans came belonged to several tribes of the Algonquian Indian family. The Pequot, the most powerful tribe, lived in the south near the Thames River. The Mohegan, a branch of the Pequot tribe, lived near present-day Norwich. Uncas, the Mohegan chief, was characterized as an ideal Indian in James Fenimore Cooper's novel *The Last of the Mohicans.* Other Connecticut tribes included the Niantic, Paugusset, Quinnipiac, Saukiog, Siwanog, Tunxis, and Wangunk.

Dutch exploration. Adriaen Block, a Dutch explorer, sailed up the Connecticut River in 1614. Block claimed Connecticut for the Dutch as part of their colony of New Netherland. The Dutch did not act on this claim until 1633 when they built a small fort—called the *House of Hope*—on the present site of Hartford. But the Dutch never settled permanently in Connecticut. They claimed parts of Connecticut off and on until 1674, when the English finally drove them out of the area.

English settlement. English colonists from Massachusetts established Connecticut's first permanent settlements. These early settlements included Hartford, New London, Saybrook, Wethersfield, and Windsor. In 1636, Hartford, Wethersfield, and Windsor united to form the *Connecticut Colony* (also called the *River Colony).* In 1638, New Haven was founded as an independent colony. It was originally a Puritan *theocracy* (church-ruled state). Beginning in 1643, other towns—including Branford, Guilford, Milford, Stamford, and Southold, on Long Island—joined the New Haven Colony.

Many early Connecticut settlers left Massachusetts in search of political and religious freedom. The most famous of these settlers was Thomas Hooker, a Congregational minister and the chief founder of Hartford. In 1638, Hooker preached a sermon calling for government based on the will of the people. The Connecticut Colony put his principle into practice in 1639, by adopting the Fundamental Orders as its law. The Fundamental Orders gave voters the right to elect government officials. The Fundamental Orders are regarded by some people as the first written constitution.

The Pequot War. Connecticut colonists feared the Pequot Indians because the tribe had attacked their settlements. The Pequot feared the colonists as a threat to Pequot supremacy in the region. Captain John Mason, aided by Mohegan and Narragansett warriors, led a small army against the Pequot in Mystic in 1637. The soldiers burned a Pequot fort, killing hundreds of Indians. Also in 1637, colonists defeated the remaining Pequot near Fairfield. See **Indian wars** (The Pequot War).

Expanding the colony. By 1660, many new towns had joined the Connecticut Colony, including Fairfield, Farmington, Middletown, New London, Norwalk, Saybrook, and Stratford. In 1662, John Winthrop, Jr., of the Connecticut Colony got a charter from the king of England. The charter gave the colony a strip of land 73 miles (117 kilometers) wide from Narragansett Bay to the Pacific Ocean. People of the time did not know that the distance to the Pacific Ocean was so great. This strip included the New Haven Colony. At first, New Haven objected to being part of the Connecticut Colony. But in December 1664, New Haven agreed to unite. The unification process was completed in April 1665.

Colonial life. The earliest Connecticut colonists were farmers. Most of them raised only enough food for their

Historic Connecticut

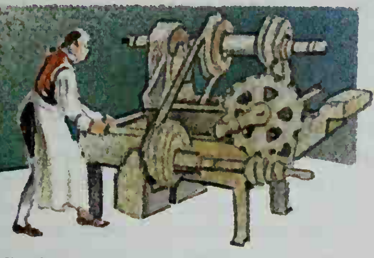


The Fundamental Orders were adopted by the Connecticut Colony in 1639. They set forth the idea of government by the consent of the people.

Samuel Colt invented the first successful repeating pistol, patented in the United States in 1836. Colt made firearms in his Hartford factory.



Litchfield Law School, founded in 1774, was the nation's first institution devoted entirely to teaching law.



Eli Whitney helped develop mass production in the early 1800's. Working in Hamden, he showed the advantages of using standard parts in gunmaking.

The U.S.S. *Ohio,* the first *Ohio* class submarine, was built at Groton and commissioned in 1981. Boats of this class are the largest and most powerful U.S. submarines ever built.

WORLD BOOK illustrations by Kevin Chadwick

Important dates in Connecticut

1614 Adriaen Block claimed Connecticut for the Dutch.

1633 The first English settlement in Connecticut was made in Windsor.

1636 The towns of Hartford, Wethersfield, and Windsor united to form the Connecticut Colony.

1637 Connecticut and other colonies defeated the Pequot Indians in the Pequot War.

1638 A group of wealthy Puritans founded New Haven.

1639 The Connecticut Colony adopted the Fundamental Orders.

1662 The Connecticut Colony received a charter from England. This charter served as Connecticut's constitution until 1818.

1665 The Connecticut and New Haven colonies united.

1687 Colonists preserved the Connecticut charter by hiding it, presumably in the Charter Oak in Hartford.

1776 Connecticut passed a resolution in favor of independence from Britain on June 14.

1788 Connecticut became the 5th state when it ratified the U.S. Constitution on January 9.

1910 New London became the home of the U.S. Coast Guard Academy.

1954 The *Nautilus,* the first nuclear-powered submarine, was built and launched in Groton.

1965 Connecticut apportioned its legislative districts on the basis of population. Connecticut adopted a new constitution.

1979 Connecticut passed a law banning the construction of additional nuclear power plants. Existing plants were allowed to continue operating.

1991 Connecticut established an individual income tax to raise additional state revenue.

own needs. Each family made most of its own clothing, household utensils, and farm tools.

During the late 1600's, Connecticut began exporting farm products to other lands, especially to the West Indies. Manufacturing started in Connecticut during the early 1700's. Clockmaking, shipbuilding, and silversmithing were the first important industries. Two brothers, Edward and William Pattison, made the first tinware in North America in the 1740's. The Pattison brothers became the first of Connecticut's famous *Yankee peddlers*. These house-to-house salesmen traveled in small carts selling a variety of Connecticut products. They were such shrewd businessmen that stories arose accusing them of selling wooden nutmegs. The stories gave Connecticut the nickname of the *Nutmeg State*.

Defending the colony. Sir Edmund Andros, named by the English king as governor of several other New England colonies, twice tried to gain control of Connecticut. In 1675, he sent troops to seize a fort in Saybrook. But his forces withdrew because Connecticut resisted strongly and the soldiers wanted to avoid a bloody battle. In 1687, Andros arrived in Hartford and demanded Connecticut's charter. But the people refused to give it to him. They supposedly hid the charter in a large oak tree, later called the Charter Oak.

The Revolutionary War. During the 1760's, Britain passed a series of laws that caused unrest in Connecticut and the other American Colonies. Some of these laws set up heavy taxes and restricted colonial trade. A few Connecticut colonists urged loyalty to Britain. But the great majority supported independence, and on June 14, 1776, Connecticut passed a resolution favoring it. About three weeks later, on July 4, the colonies adopted the Declaration of Independence. On July 9, 1778, Connecticut *ratified* (approved) the Articles of Confederation, the forerunner of the U.S. Constitution.

After the Revolutionary War began in Massachusetts in 1775, hundreds of Connecticut men joined the patriot forces. Governor Jonathan Trumbull and Nathan Hale rank among the most famous Connecticut patriots. Trumbull was the only colonial governor to hold office throughout the Revolution. He was a close friend and trusted adviser of General George Washington, who called him *Brother Jonathan* (see **Brother Jonathan**). Nathan Hale was hanged by the British as a spy. His dying words won him lasting fame: "I only regret that I have but one life to lose for my country."

During the Revolutionary War, Connecticut's long coastline lay open to attack from British-controlled Long Island, only a few hours away by boat. The British launched five major assaults and countless minor raids against the state. Although Connecticut lacked sufficient forces to protect its own coast, the state was asked to supply large detachments to the Continental Army to help defend the Hudson River in New York. The conflict over whether state or national defense should be more important created serious disputes among Connecticut's political leaders throughout the war.

Statehood. At the Constitutional Convention of 1787, Connecticut's delegates supported the establishment of a strong national government. They played an important role in bringing about the *Great Compromise* (sometimes called the *Connecticut Compromise*). Convention delegates from large states wanted a state's representation in Congress to be based on population. Delegates from small states wanted all states to have equal representation in Congress. The compromise provided for representation in proportion to population in the House of Representatives and equal representation in the Senate. It enabled the large and small states to join in supporting a central government that had substantial powers. Connecticut ratified the U.S. Constitution on Jan. 9, 1788, becoming the fifth state to join the Union.

During the 1780's, Connecticut gave up claims to most of the western land that the colony had been granted in the 1662 charter. Connecticut kept only its claim to the Western Reserve. Most of this land in northeastern Ohio was sold to the Connecticut Land Company in 1795. The money from the sale was used for education.

The 1800's. Until the 1850's, most of Connecticut's people continued to work on farms. But before 1900, Connecticut had become a thriving industrial state.

Connecticut owes much of its industrial importance to the inventors who worked there. Perhaps the most important of these inventors was Eli Whitney. Whitney is best known for his cotton gin. But he also helped develop the modern system of mass production. While working in Hamden in the early 1800's, Whitney built machine tools that made interchangeable gun parts. Until that time, all gun parts were made by hand and part of one gun usually would not fit another gun.

In 1808, Eli Terry of East Windsor became the first person to make clocks by mass production. In 1810, Rodney Hanks and his nephew, Horatio Hanks, built the nation's first silk mill in Mansfield. Samuel Colt of Hartford invented the first successful repeating pistol and obtained a U.S. patent for it in 1836. Colt made pistols and other firearms in his Hartford factory. In 1839, Charles Goodyear of Connecticut found a way to *vulcanize* (strengthen) rubber. Goodyear patented his vulcanization method in 1844. People from Connecticut also pioneered in making bicycles, cigars, copper coins, nuts and bolts, pins and needles, silk thread, and rubber shoes.

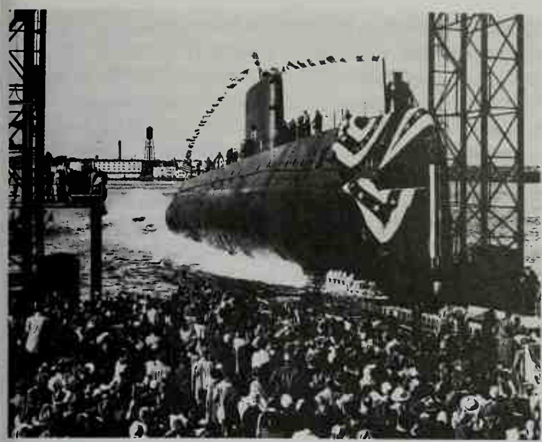
Connecticut became a leading textile producer in the early 1800's, borrowing technology, capital and labor from Rhode Island. This industry dominated much of eastern Connecticut throughout the 1800's.

Improved transportation helped Connecticut grow industrially. Fifteen railroad companies were organized in the state between the 1830's and 1850's. Steamships began serving Connecticut ports in the early 1800's. With these facilities, industries could import large quantities of raw materials inexpensively. Connecticut's industrial growth also was aided by thousands of Canadian and European immigrants. These workers provided relatively inexpensive factory labor.

Connecticut strongly supported the Union during the American Civil War (1861-1865). Over 50,000 men joined the Union forces, and the state's industries helped produce arms, munitions, and other military needs.

The early 1900's. Many immigrants settled in Connecticut during the late 1800's and early 1900's. By 1910, about 30 percent of the state's population was made up of people who were born outside the United States. Most of these people settled in cities. By 1910, almost 90 percent of Connecticut's people lived in urban areas.

In 1910, the U.S. Coast Guard Academy was moved to



Electric Boat Division

The *Nautilus,* the world's first nuclear-powered submarine, was launched at Groton in 1954. On its maiden voyage, it broke all submarine records for underwater speed and endurance.

New London from headquarters in Maryland and Massachusetts. The U.S. Navy opened a submarine base in nearby Groton in 1917. After the United States entered World War I in 1917, many of the nation's largest munitions factories operated in Connecticut. About 67,600 people from Connecticut served in the armed forces during the war.

Connecticut industry continued to grow during the 1920's. At the same time, the Republican Party controlled Connecticut politics. The Great Depression of the 1930's slowed industry and caused widespread unemployment in Connecticut. The Depression swung many Connecticut voters over to the Democratic Party. Wilbur Cross, a Democrat, won election as governor four times during the 1930's. Economic conditions improved when the Depression eased in the late 1930's.

The mid-1900's. During World War II (1939-1945), Connecticut was an important supplier of war materials. The state's factories made airplane engines, patrol boats, propellers, shell cases, and submarines.

Connecticut industry kept pace with the nuclear age and space age during the 1950's and 1960's. In 1954, the *Nautilus,* the world's first nuclear-powered submarine, was built and launched at Groton. In the late 1960's, the Groton shipyard began to build nuclear submarines that were armed with more powerful missile weapons. A nuclear energy plant for the production of electric power began to operate at Haddam Neck in 1968.

Also in the 1960's, Stratford plants produced reentry vehicles for spacecraft, and Middletown factories made small tape recorders to send signals into outer space. In 1969, when U.S. astronauts became the first people to walk on the moon, they carried oxygen and other supplies in backpacks made in Connecticut.

The 1950's and 1960's brought changes in the state government. In 1955, the Connecticut legislature approved new laws that gave voters a direct voice in choosing candidates for state elections. In 1964, Connecticut redrew the boundaries of its congressional districts. Six new districts with more equal populations were created for congressional elections.

Also in 1964, a federal court ruled against Connecticut's 327-year-old system for electing state legislators. Under this system, each town, regardless of its population, could elect at least one legislator. As a result, 10 percent of the voters could elect a majority of the legislators. This was possible because many thinly populated areas elected as many legislators as did heavily populated areas. In 1965, Connecticut *reapportioned* (redivided) its legislative districts to provide representation based on population. The Democrats, who were stronger in the large population centers, gained power.

Connecticut adopted its present constitution in 1965. The Constitution requires that the legislature be reapportioned after each federal census.

During the 1950's and 1960's, many communities tore down poor sections and replaced them with new buildings. The construction of Hartford's Constitution Plaza turned a run-down area into an attractive business district. State spending for education, welfare, and other citizen services also rose during this period.

The late 1900's. In the late 1960's and early 1970's, the state legislature passed laws to reduce air and water pollution. In 1979, the legislature passed a law prohibiting the construction of additional nuclear power plants. Existing plants were allowed to continue operating. However, the plant at Haddam Neck closed in 1997.

In the late 1900's, population growth and rapid industrial growth brought many problems, including crowded cities and highways and soaring costs for education and housing. In 1979, the legislature developed a system that provided increased state aid for needy school districts. In the 1980's, Connecticut used part of its revenues to rebuild bridges and expand educational services. The end of the Cold War in the late 1900's resulted in fewer government contracts for military equipment. This led to reduced employment in the state.

State revenue developments. The state government adopted the state's first individual income tax in 1971. But after public protests, the state government repealed the tax and raised taxes on cigarettes, gasoline, and general sales. It established a lottery in 1971 to raise additional revenue. The government later developed more sources of revenue by permitting betting on greyhound racing and by legalizing other forms of gambling. In 1991, the government again adopted an individual income tax. Casino gambling began in the state in 1992.

Thomas R. Lewis and Barbara M. Tucker

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History

Charter Oak	Mystic Seaport
Colonial life in America	New Netherland
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Mohegan Indians	

Physical features

Connecticut River	Housatonic River

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Questions

Why is Connecticut called the *Constitution State?*
What is Connecticut's chief manufacturing activity?
Which Connecticut newspaper is the oldest continuously published newspaper in the United States?
What were the *Fundamental Orders?*
Where in Connecticut was the nation's first silk mill built?
What helps to protect Connecticut's shore from Atlantic storms?
Which city in Connecticut is called the *Insurance City?*
Who was Tapping Reeve?
What conflict created serious disputes among Connecticut's political leaders during the Revolutionary War?
What is the oldest library still operating in Connecticut?

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Connecticut, University of, is a state-supported coeducational university in Storrs, Connecticut. Schools and colleges at the university include agriculture, allied health professions, business administration, education, engineering, family studies, fine arts, liberal arts and sciences, nursing, and pharmacy. The university has branches in Groton, Hartford, Stamford, and Waterbury, and it offers courses at the Litchfield County Center for higher education in Torrington. It has schools of law and social work in Greater Hartford. The schools of medicine and dental medicine are in Farmington. Courses at the university lead to bachelor's, master's, and doctor's degrees. The university was founded in 1881.

Critically reviewed by the University of Connecticut

Connecticut River rises in northern New Hampshire, and forms the boundary between that state and Vermont. It then cuts across Massachusetts and Connecticut to empty into Long Island Sound. The river is 407 miles (655 kilometers) long. Industrial towns grew up along its middle course to take advantage of the power from its falls and rapids. Industries along the river include paper mills and hydroelectric power plants. John L. Allen

Connective tissue holds together and gives shape to body organs and tissues. It also holds organs in place and supports the body. Compared with other types of tissue, connective tissue has relatively few cells and much *intercellular substance* (material outside the cells). Scientists divide connective tissue into three groups, according to the hardness of the intercellular substance. These groups are (1) soft *connective tissue proper,* (2) firm *cartilage,* and (3) hard *bone.* This article discusses connective tissue proper. For information on the other kinds of connective tissue, see **Bone; Cartilage.**

There are two chief types of connective tissue proper —*loose* and *dense.* Loose connective tissue forms the networks of thin fibers that surround such organs as the heart and lungs. It is also found under the skin and over the muscles. Dense connective tissue has more fibers and greater strength than does loose connective tissue. It forms tough capsulelike coverings that keep such organs as the kidneys in place. Dense connective tissue also forms the *ligaments,* which hold the bones and joints in place, and the *tendons,* which connect the muscles to the bones (see **Ligament; Tendon**).

In addition, connective tissue proper stores fat cells. Specialized kinds of this tissue, called *reticular tissue,* manufacture red and white blood cells.

The intercellular substance of connective tissue proper consists of long fibers mixed with a jellylike material. The fibers are mostly made up of a protein called *collagen* (see **Collagen**). Most collagen fibers resemble strong cords, but some form strands of delicate reticular tissue. Other fibers consist of a protein called *elastin,* which stretches easily. George P. Stricklin

See also **Marfan syndrome.**

Connelly, Marc (1890-1980), wrote *The Green Pastures* (1930), perhaps America's most popular religious drama. The play has an all-black cast and is written in the dialect of Southern blacks. It takes place in heaven, and God (called "De Lawd") is the chief character. "De Lawd" changes from the Old Testament God of wrath to a God of mercy. The play is filled with humor and the recognition of human dignity. It won a Pulitzer Prize in 1930.

Connelly and George S. Kaufman earlier collaborated to write several lively, satirical comedies. *Dulcy* (1921), the best of their comedies, brought stardom to actress Lynn Fontanne. But their most significant collaboration was *Beggar on Horseback* (1924), an expressionistic dream play adapted from a German script. The play shows the forces in everyday life that oppose the creative person. Marcus Cook Connelly was born in McKeesport, Pennsylvania. Frederick C. Wilkins

Connors, Jimmy (1952-), is an American tennis champion. He was one of the best singles players in the world. In 1974, Connors won the men's singles title at three major tennis tournaments—the All-England (Wimbledon) Championships, the United States Open, and the Australian Open. Connors also won the U.S. Open in 1976, 1978, 1982, and 1983. In addition, he won Wimbledon in 1982. Connors won a record 109 professional singles titles during his career. He last competed in the U.S. Open in 1992 at the age of 40 and went on to play in World Team Tennis and in the senior champions tour that he co-founded in 1993.

Connors, a left-hander, was known for an aggressive, hard-hitting style of play that put constant pressure on his opponents. He was particularly noted for his return-of-service and for his two-handed backhand.

James Scott Connors was born on Sept. 2, 1952, in East St. Louis, Illinois, and grew up in Belleville, Illinois. He attended the University of California at Los Angeles (UCLA). In 1971, he won the National Collegiate Athletic Association singles championship. Connors became a professional tennis player in 1972. Arthur Ashe

Conquistadors, *kahn KEES tuh dawrz,* were Spaniards who conquered Indian peoples in parts of Latin America mainly during the first half of the 1500's. *Conquistador* is a Spanish word meaning *conqueror.* Most conquistadors had little interest in exploration. Nevertheless, they were often the first Europeans to enter the regions they conquered, and some settled in those areas. The most famous conquistadors were Hernando Cortés, who defeated the Aztec Indians in Mexico, and Francisco Pizarro, who conquered the Inca empire in Peru. Helen Delpar

See also Cortés, Hernando; Pizarro, Francisco.

Conrad, Charles, Jr. (1930-1999), a United States astronaut, commanded the Apollo 12 mission that made the second manned moon landing. On Nov. 19, 1969, Conrad and astronaut Alan L. Bean landed in their lunar module, Intrepid, and stayed for about 31 hours. Conrad and Bean set up scientific instruments and collected rock and soil samples. They also removed parts from Surveyor 3 for scientific examination. Surveyor 3 was a remotely controlled spacecraft that had landed on the moon in April 1967. In 1973, Conrad was commander of the initial mission of the first U.S. space station, Skylab. Working in space, he helped repair the station's solar panel wing. This work made the station safe.

Charles "Pete" Conrad was born on June 2, 1930, in Philadelphia. In 1953, he graduated from Princeton University and entered the Navy. He completed Navy Test Pilot School and then served as a flight instructor. He became an astronaut in 1962. In 1965, Conrad piloted the Gemini 5 mission. He commanded the Gemini 11 mission in 1966.

In 1974, Conrad retired from the astronaut program and the Navy. He then served as staff vice president for the New Business Space Systems Division of the McDonnell Douglas Corporation. Lillian D. Kozloski

Conrad, Joseph (1857-1924), was a Polish-born author who wrote in English. He became famous for the novels and short stories that he wrote about the sea.

Conrad was born Józef Teodor Konrad Nalecz Korzeniowski on Dec. 3, 1857, near Kiev, in what was then Russian Poland. He left Poland at the age of 16 and arrived in England at the age of 20, unable to speak English. During the next 16 years, he worked his way up from deck hand to captain in the British Merchant Navy. He mastered English so completely that he was able to write some of its greatest novels. Conrad's rich prose style is noted for its gripping intensity, which can be precise in its realism or filled with metaphor.

Conrad used experiences of his life in many of his works. From his voyages in the Indian Ocean and Malay Archipelago came some of his best-known novels. He began with *Almayer's Folly* (1895) and *An Outcast of the Islands* (1896), both set in Borneo.

Such later masterpieces as *The Nigger of the "Narcissus"* (1897), *Lord Jim* (1900), *Typhoon* (1903), and *The Shadow Line* (1917) are also set in the eastern seas. Several of his short stories, including "The Secret Sharer" and "Youth," are set there, too. "Heart of Darkness" is based on his voyage up the Congo River, and his novel *Nostromo* (1904) uses memories of his early voyages in the Caribbean.

His sea stories were not superficial adventure tales, though they were sometimes dismissed as such in his day. Later critics hailed Conrad for his experiments with fictional point of view and multiple narrators. Conrad's work is also exceptional for its probing psychological analysis of the isolated self torn between such conflicting influences as sympathy and greed, heroism and cowardice, and idealism and cynicism. In *Nostromo,* for example, Conrad presented an epic picture of the clash between capitalism and revolution in South America. Conrad also wrote two absorbing novels about revolutionaries in Europe, *The Secret Agent* (1907) and *Under Western Eyes* (1911), and the autobiographical pieces collected in *The Mirror of the Sea* (1906) and *A Personal Record* (1912). After years of praise from critics but little public attention, Conrad only began to achieve popular success with the more melodramatic material of his novels *Chance* (1914) and *Victory* (1915). Garrett Stewart

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Conrail, a United States railroad, was one of the largest freight carriers in the nation. It operated about 13,000 miles (21,000 kilometers) of rail routes in 14 Eastern and Midwestern states, the District of Columbia, and the Canadian province of Quebec. The name *Conrail* stands for *Consolidated Rail Corporation.*

Congress provided for the organization of Conrail through the Regional Rail Reorganization Act of 1973. The Railroad Revitalization and Regulatory Reform Act of 1976 authorized Conrail to take over the operations of the bankrupt Penn Central Transportation Company and five other bankrupt railroads. These railroads included the Erie Lackawanna, Reading, and Lehigh Valley. The Penn Central had been formed in 1968 by the merger of the Pennsylvania and New York Central railroads. Conrail was technically a private corporation. But the U.S. government provided loans and loan guarantees to Conrail and named a majority of its directors.

The Northeast Rail Service Act of 1981 gave Conrail

greater flexibility to eliminate unprofitable routes and improve worker productivity. Under the act, the federal government acquired nearly all the company's stock. In 1987, the United States government sold all its Conrail stock to private investors. In 1998, the government approved the division of Conrail's assets between two other railroads—CSX and Norfolk Southern. These railroads absorbed most of Conrail's assets, but they still operate Conrail jointly as a local rail freight company serving New Jersey, Detroit, and Philadelphia.

Richard Saunders, Jr.

Conscientious objector is a person who claims that his beliefs prevent him from bearing arms in his country's armed forces. Almost all conscientious objectors have been men because few countries require women to do military service. A conscientious objector may be willing to serve in the military, but only as a noncombatant, such as a medical corpsman. Or he may claim that his principles do not allow him to take part in any effort associated with war. The United States and the United Kingdom were among the first countries to consistently accept conscientious objection in exempting people from military service or combat training.

The history of conscientious objection in the United States dates back to colonial times. The first conscientious objectors in America were members of pacifist religious groups, such as the Quakers. In 1661, Massachusetts became the first colony to exempt conscientious objectors from service in its militia.

Congress passed the first federal draft law during the American Civil War (1861-1865). This law recognized conscientious objectors. They received special consideration in both the North and the South. To be classified as a conscientious objector, a man had to belong to a pacifist religious group. This requirement was also followed during World War I (1914-1918). Men classified as conscientious objectors were excused from combat. However, they were expected to perform some sort of military service.

The 1940 draft law required "religious training and belief," but not necessarily membership in a pacifist religious group, for conscientious objection. The 1948 draft law defined religious belief as belief in a "Supreme Being." But Congress removed the term "Supreme Being" in the 1967 law because the Supreme Court of the United States interpreted the term to include vaguely religious philosophies. From 1967 to 1970, exemptions were granted chiefly to people whose "religious training and belief" led them to believe all war is wrong.

The religious requirement was questioned during the 1960's. Many men sought exemptions on the basis of their personal philosophy or their belief that the Vietnam War (1957-1975) was immoral. Major churches supported selective objection—the refusal to serve in a particular war. In 1970, the Supreme Court exempted from military service "all those whose consciences, spurred by deeply held moral, ethical, or religious beliefs, would give them no rest or peace if they allowed themselves to become part of an instrument of war." Many countries provide alternative forms of national service for objectors in an effort to reconcile the claims of national security and individual conscience. Charles Chatfield

See also Draft, Military; Pacifism.

Conscription. See Draft, Military.

Conservation

Conservation is the management, protection, and wise use of natural resources. Natural resources include all the things that help support life, such as sunlight, water, soil, and minerals. Plants and animals are also natural resources.

The earth has limited supplies of many natural resources. Our use of these resources keeps increasing as the population grows and our standard of living rises. Conservationists work to ensure that the environment can continue to provide for human needs. Without conservation, most of the earth's resources would be wasted, degraded, or destroyed.

Conservation includes a wide variety of activities. Conservationists work to keep farmlands productive. They manage forests to supply timber, to shelter wildlife, and to provide people with recreational opportunities. They work to save wilderness areas and wildlife from human destruction. They try to find ways to develop and use mineral resources without damaging the environment. Conservationists also seek safe, dependable ways to help meet the world's energy needs. In addition, they work to improve city life by seeking solutions to air pollution, waste disposal, and urban decay.

Conservationists sometimes divide natural resources into four groups: (1) inexhaustible resources, (2) renewable resources, (3) nonrenewable resources, and (4) recyclable resources.

Inexhaustible resources, such as sunlight, cannot be used up. Conservation experts consider water an inexhaustible resource because the earth will always have the same amount of water. But water supplies vary from one area to another, and some areas have shortages of clean, fresh water. The supplies of salt and some other minerals are so abundant that they are not likely to be used up.

Renewable resources can be used and replaced. They include plants and animals, which reproduce and so replace themselves. Most renewable resources cannot be stored for future use. For example, old trees rot and become useless for timber if they are not cut down, though rotting trees can serve such important purposes as providing habitat for wildlife. In addition, because most renewable resources are living things, they interact with one another. Thus, the use of one such resource affects others. For example, cutting down trees affects many plants and animals, as well as soil and water resources. Soil may be considered a renewable resource because crops can be grown on the same land for years if farmers care for the soil properly. But if farmers allow the soil to wash or blow away, it will take hundreds of years to replace.

Nonrenewable resources, such as coal, iron, and petroleum, cannot be replaced. They take thousands or millions of years to form. People deplete supplies of these resources faster than new supplies can form. We can store most nonrenewable resources for future use.

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Mining companies sometimes leave minerals in the ground to save them for the future. Little interaction occurs among most nonrenewable resources, so using one nonrenewable resource has little effect on another.

Recyclable resources, such as aluminum and copper, can be used more than once. For example, aluminum can be used to make containers and then be reprocessed and reused.

People have practiced some kinds of conservation for hundreds of years. As a popular movement, however, conservation began in the United States during the early 1900's. The word *conservation* was probably first used by Gifford Pinchot, head of the U.S. Forest Service during President Theodore Roosevelt's administration. The term comes from two Latin words—*servare,* which means *to keep* or *to guard,* and *con,* which means *together.* During the early 1900's, American conservationists worked chiefly to preserve the nation's forests and wildlife. Today, conservationists work in many fields, including forestry, geology, range ecology, soil science, wildlife biology, and urban planning. Conservationists are also called *environmentalists.*

One of the most difficult challenges of conservation is to reconcile two, sometimes conflicting, goals—(1) to protect the environment and (2) to maintain or increase agricultural and industrial production. For example, the agricultural use of some chemical fertilizers and pesticides pollutes the environment but also greatly increases crop yields. Thus, most farmers do not want to stop using these chemicals, even though it would be best for the environment. Only the combined efforts of many people can solve such problems. Business leaders, government officials, scientists, and individuals must all work together to conserve natural resources.



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Conservation includes the efforts of individual people to preserve natural resources. These student volunteers preserve live Christmas trees by planting them at their school.

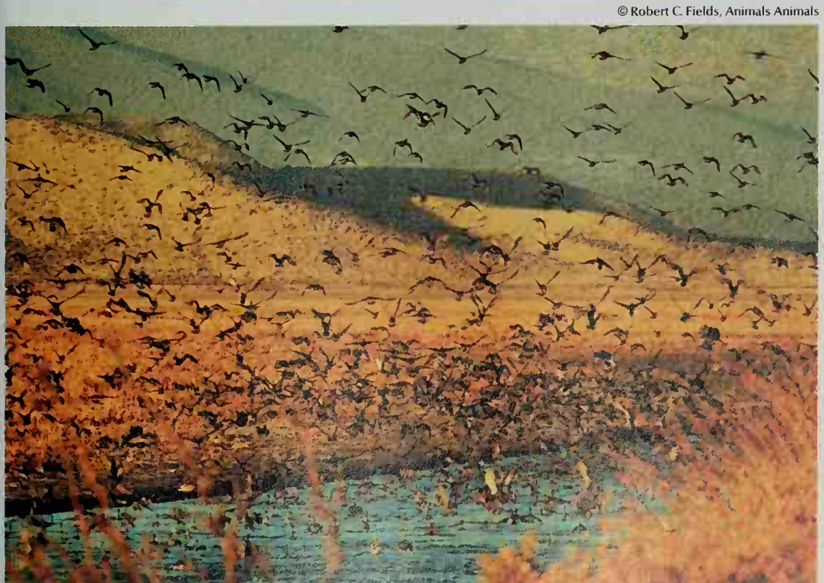
The importance of conservation

Conservation is important for many reasons. Farmers may practice conservation to prevent erosion and to maintain the quality of the soil. City dwellers may be chiefly concerned about air pollution, inadequate parks, and decaying neighborhoods. Nature lovers appreciate the beauty and other values of wildlife and landscapes. Business executives may promote conservation to help ensure continuous supplies of minerals and other resources on which their industries depend. But in general, conservation is important for two basic reasons: (1) to meet demands for natural resources and (2) to maintain the quality of life.

To meet demands for resources. The demand for natural resources has steadily increased as a result of the growth of the world population and the rise in standards of living in many countries. While the demand for resources has increased, the supply has not, and some resources are being used up rapidly.

From A.D. 1 to about 1800, the world population quadrupled from about 300 million to 1 billion. But since then, the population has multiplied six times to about 6 billion. Although the rate of growth is slowing, the world is expected to have approximately 11 billion people by 2100. Such a large increase in population will result in even greater demands for natural resources. Peo-

© Robert C. Fields, Animals Animals



Wildlife conservation requires setting aside areas where animal habitats are not disturbed. Mallards and other birds nest in Lower Klamath National Wildlife Refuge in California, *shown here.*

ple will need more land for homes and agriculture. They will require more fuel and fresh water. No one knows how many people the earth can support. But most conservationists believe the rate of population growth must be reduced to keep from depleting many of our natural resources.

The rise in the standard of living in industrialized nations has created further demands for natural resources. Such industrialized nations as the United States, Canada, Australia, and Switzerland have high living standards, and they use a disproportionately large share of the world's natural resources. In addition, many less developed countries are working to raise their living standards and are increasing their demands for resources.

The high living standards in the United States and many other nations are supported largely by the growth of industry. Industry uses huge amounts of fuel and other resources, and it depends on continuous supplies of these resources. Unless people practice conservation, shortages of some resources may develop within the next 100 years.

In many cases, meeting demands for one resource makes it difficult to conserve another. The same land that is needed to produce food, wood, or fuel is often valued for its wildlife, recreational opportunities, or beautiful scenery. For example, the construction of a dam may provide water to irrigate farmland or to produce electric power. But it may also destroy scenic lands and wildlife habitats.

To maintain the quality of life. Conservationists use the term *quality of life* to refer to the health of the environment. Such factors as clean air and water, uncluttered living areas, and unspoiled scenic lands contribute to the quality of life.

Industrial development has created a high standard of living for many people. But it has also damaged the environment in ways that impair the quality of life. For example, many factories release smoke and other pollutants into the air and empty waste products into lakes and streams. As a result, the air in many cities is unhealthy to breathe, and the water in many lakes and streams is unsafe to drink or to swim in. Some methods of mining also cause pollution and may leave the land barren. In addition, the use of certain industrial products contributes to pollution. For example, the exhaust fumes from automobiles are a major source of air pollution.

To maintain or improve the quality of life, we must use natural resources in ways that cause the least possible damage to the environment. In addition, we need to preserve some places in their natural state and protect them from any form of development. Certain species can survive only in natural environments, such as prairies, wetlands, and forests. These habitats provide homes for many kinds of wildlife. Preserving such habitats contributes to the *biological diversity,* or *biodiversity,* of the earth—that is, its variety of plant and animal species. If we do not preserve such environments, large areas of the earth will support only a few species of plants and animals.

The number of species has already declined greatly in many parts of the world. For example, corn and wheat fields have replaced most of the prairies of North America. As a result, such wildlife as pronghorns and prairie chickens, once plentiful on the prairies, are no longer abundant throughout their former ranges. Such prairie plants as Pitcher's thistle and running buffalo clover have also become threatened. Conservationists are working to protect the few remaining prairies and to preserve other natural environments.

Kinds of conservation

This section divides the broad field of conservation into nine main categories. They are (1) biodiversity conservation, (2) water conservation, (3) ocean conservation, (4) soil conservation, (5) conservation of grazing lands, (6) forest conservation, (7) mineral conservation, (8) energy conservation, and (9) urban conservation.

Each kind of conservation has different problems and solutions. Often, however, the management of one resource affects several other resources. For example, the conservation of forests helps conserve biodiversity, water, and soil. Forests absorb rain water and so keep it from running off the land too rapidly. They thus help prevent rain water from washing away the soil. Forests also provide homes for animals, plants, and other living things. In fact, a forest constitutes an *ecosystem,* a group of living organisms interacting with one another and with their physical environment.

This section deals mainly with conservation problems and practices in the United States. But much of the information applies to other countries as well. The section *Conservation around the world* discusses specific conservation concerns in other countries.

Biodiversity conservation. Biodiversity, also called biological diversity, refers to the great variety of the world's living creatures. Animals, plants, and other living things make up an essential feature of nature, and they contribute to the beauty and wonder of life. Although biologists cannot agree on the true number of species on the earth, scientists have classified between 1,400,000 and 1,700,000 species. Most specialists, however, believe at least 4 million other species remain unstudied, and some scientists speculate that that number may be more than 30 million. Different populations of a single species may also differ *genetically* from one another. That is, they possess different *genes,* the biological structures that carry specific traits from one generation to the next. Genetic differences add to biodiversity.

Through the ages, human activities have contributed to the extinction of numerous animal and plant species. Such extinct species include the passenger pigeon of North America and the Tasmanian tiger of Australia. Today, human activities threaten the survival of other animals and plants. Conservationists classify more than 8,000 species around the world as *endangered* (near extinction), and many other species that have been poorly studied may be equally in peril.

In the past, uncontrolled hunting was a major cause of endangerment and extinction. But today, many countries have laws that protect animals by regulating hunting and fishing. The destruction of habitat is the major threat to both animals and plants today. Although such legislation as the U.S. Endangered Species Act of 1973 protects the habitat of species listed as endangered or threatened, no laws protect the habitats of many other species whose numbers are dwindling. Development of land for homes, farms, industries, and transportation leaves fewer areas where wild animals and plants can

live and reproduce. Pollution also damages natural habitats. Chemicals from sewage, industrial wastes, fertilizers, and pesticides build up in lakes and streams and in the soil.

Human beings also bring species of plants and animals from their native regions to other areas of the world. These *nonindigenous species* present a major threat to biodiversity. They often lack natural enemies in their new homes, enabling them to multiply quickly and drive out native animals and plants. The South American banana poka plant, for instance, has disrupted the native ecosystem of Hawaii. It has killed off many native trees and now dominates vast tracts of land. By destroying native trees, the banana poka threatens the existence of native animals that rely on these trees. Nonindigenous species can also harm people. One example, the South American red imported fire ant, has spread to North America and caused vast agricultural damage. In addition, many introduced species of animals and plants carry diseases that devastate native species.

A chief goal of conservation is to ensure the survival of animal and plant species. Conservation thus includes the enforcement of hunting and fishing laws, as well as laws protecting endangered species and regulating the importation of nonindigenous species. In many cases, an entire habitat requires protection and management. Some areas must then be set aside as national parks, state parks, nature reserves, and wildlife refuges. Farmers can help conserve such wildlife as rabbits and quail by leaving strips of natural vegetation along the edges of their fields. They can also reduce the use of harmful pesticides and fertilizers.

The populations of some species of animals and plants have dwindled to the point that they cannot survive in their natural environments. Zoos, botanical gardens, and other facilities attempt to breed these species in *captive breeding* programs. Sometimes they produce a large enough population for release into a protected area.

Water conservation. People require clean, fresh drinking water. People also use water for bathing, cooking, and cleaning. Farmers need water to irrigate dry croplands. Industries use water to produce electric power and in the manufacture of many products. Water is also important in recreation and transportation.



Biodiversity conservation includes raising endangered animals in captivity. This conservationist is feeding a bush dog pup at Port Lympne Wild Animal Park in the United Kingdom.

The demand for water constantly increases as a result of population growth and the expansion of agriculture and industry. The earth has an abundant supply of water, but the water is unevenly distributed. Some areas do not receive enough rainfall, while others get more than they need.

Many dry regions of the world, such as the Middle East, North Africa, and parts of western and central North America, face serious water shortages. In some areas, people obtain water by drilling wells to tap underground supplies. But in parts of the western and central United States, farmers have drilled so many wells to provide water for irrigation that the level of the ground water has been greatly lowered. Many cities have also used up much of their ground water. In some cases, underground reservoirs can be refilled by pumping in water during periods of heavy rainfall.

Some rural areas and cities obtain water by damming rivers to create reservoirs. Engineers also built dams to control flooding. But in many cases, the construction of new dams to meet ever-increasing demands for water or to reduce flooding threatens wildlife. For example,



Water conservation aims to preserve supplies of clean, fresh water. This scientist in India is collecting samples of polluted water, which has turned yellow because of chemical contamination. A factory is dumping this water into a ditch. Such water could harm many kinds of living things, including animals that drink it.

during the late 1970's, conservationists opposed the construction of the Tellico Dam on the Little Tennessee River because of its possible harmful effect on a rare species of fish called the snail darter. The dam was completed in 1979, and some snail darters were transferred to the Hiwassee River in Tennessee in an attempt to ensure their survival.

A dam may harm certain fish because it reduces the flow of water. Dams can also prevent such migrating fish as salmon from reaching their breeding grounds. As the land behind a dam becomes flooded, the water destroys some wildlife habitats. Certain streams should not be dammed because they carry too much silt. On such streams, reservoirs quickly fill up with silt and can no longer store water.

People also deplete lakes to provide water for irrigation. Such irrigation practices have caused the Aral Sea, a saltwater lake in central Asia, to shrink to about 40 percent of its original size.

Water supplies for cities and farms can be increased partly through *watershed management* (the management of vegetation to prevent rapid runoff of rain and melting snow). Trees and other plants keep water from running off the land and so enable it to filter into the ground. The water thus refills underground supplies and flows through underground channels into lakes and streams. The destruction of plant cover disturbs this natural cycle. Rain water runs off the land rapidly instead of filtering into the ground. Watershed management also helps reduce flooding and soil erosion.

Some cities near seacoasts meet part of their water needs by desalting seawater. This process, called *desalination,* requires massive amounts of energy and is thus expensive. For this reason, desalination is not yet practical on a large scale. But solar energy may one day provide enough cheap power for large-scale desalination.

Many communities have problems with water pollution. The disposal of sewage, industrial chemicals, and other wastes into lakes and streams makes the water unhealthy for wildlife and human beings. Even bodies of water as large as Lake Erie have become seriously polluted. Cities and industries can reduce pollution by removing harmful substances from wastes before emptying the wastes into lakes and streams. But waste treatment is expensive, and the job of cleaning up lakes and streams will take years. See **Water pollution.**

Ocean conservation. The oceans make up more than 70 percent of the earth's surface and provide homes to vast numbers of living species. They also help keep the world's climate from becoming too warm. Oceans do this by storing carbon dioxide gas and preventing too much of the gas from entering the atmosphere. Atmospheric carbon dioxide warms the earth by absorbing heat from the sun.

People catch millions of tons of ocean fish and shellfish each year. This catch yields a major source of animal protein in many countries. Increasingly, people also eat such ocean species as seaweed, sea urchins, and other marine organisms. Medical science uses chemicals from some marine organisms to fight cancer and other diseases. In addition, oceans and their shores provide people with recreational activities, including boating, fishing, and swimming.

The oceans receive ever greater amounts of pollution as human population grows and shipping increases. Industrial wastes often find their way into the oceans, either directly or indirectly through rivers. Single accidents involving large oil tankers can foul an entire coastal region, killing thousands of living things. Underwater mining and excavation spills such toxic materials as heavy metals and pesticides into ocean waters. Every year, people also throw millions of tons of litter into the oceans from ships. Millions of seabirds, turtles, fish, and marine mammals die annually from becoming entangled in or consuming discarded plastic items in the litter. Concentration of pollutants also renders beaches unsafe for people.

Overharvesting ranks as the other major threat to ma-



Ocean pollution can damage shorelines as well as the oceans themselves. These conservation workers are cleaning up an oil spill along a coastal area in Puerto Rico.

rine biodiversity. With the advent of mechanized fishing boats, overfishing increased dramatically. Many formerly productive fishing areas, including those for cod and haddock, declined greatly. Many sea creatures become *bycatch*—that is, species caught accidentally in nets set for other species. Nets used to catch shrimp, for example, also trap endangered marine turtles. Globally, overfishing and pollution have combined to cause a sharp decline in the total number of fish caught in the ocean since 1989. The total fish harvest increased, however, because of increases in *aquaculture,* also called fish farming.

Many international conservation problems involve marine animals and other ocean resources. International agreements and rigorously enforced limits on catch have saved certain international fishing areas, such as those for Pacific halibut. On the other hand, the commercial hunting of whales remains an international problem. Because of overhunting, several species of whales verge on extinction. The International Whaling Commission (IWC), an organization devoted to conserving whales, recommends that all nations should completely stop commercial whale hunting. But not every country has agreed with this recommendation.

Soil conservation. Soil is essential for the growth of plants, which in turn provide food for animals and human beings. Soil consists chiefly of minerals mixed with *organic* (plant and animal) matter. Soil forms from rocks and similar materials that are broken up into smaller particles by physical and chemical processes called *weathering.* The particles become mixed with *humus,* a substance formed from plant and animal remains. Bacteria in the soil break down the humus into nutrients needed by plants.

The thin layer of fertile soil that covers much of the land was formed by natural processes over thousands of years. But in many areas, careless human practices have destroyed the soil in just a few years.

Rain, wind, and other natural forces gradually wear away the soil. This process, called *erosion,* normally occurs slowly. But people have greatly increased the rate of soil erosion by removing natural vegetation to clear land for construction projects, mines, or farmland. Plants protect soil from rain and wind. Their roots form an underground network that holds soil in place. Plants also absorb some rain water so that less runs off the land.



Grant Heilman

Soil conservation techniques include *contour plowing,* in which farmers plow across a slope, and *strip cropping,* in which farmers alternate strips of close-growing plants and grain crops.

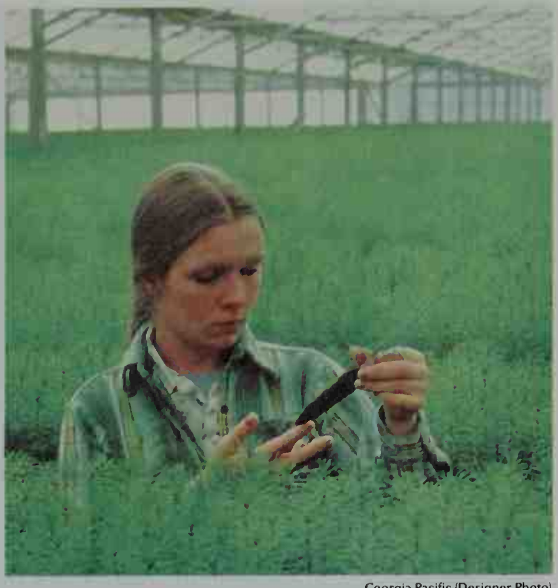
Thus, fewer soil particles are washed away.

Soil erosion has long been a major conservation problem, especially on croplands. In the United States, soil erosion has severely damaged millions of acres or hectares of land. Much of the soil eroded each year ends up in lakes, streams, and rivers.

Farmers can reduce soil erosion by planting trees and leaving patches of natural vegetation between their fields and on other unplowed areas. The trees serve as



Terracing helps check soil erosion on hillsides. The terraces hold rain water and prevent it from washing down a hillside and forming gullies.



Georgia Pacific (Designer Photo)

A tree nursery supplies seedlings for replanting forests that have been cut down for timber. Seedlings grow in a nursery for one to four years before being transplanted in a forest.

windbreaks, and the plant cover slows the runoff of rain water. Many farmers also practice such soil conservation methods as *contour plowing, strip cropping, terracing,* and *minimum tillage.*

Contour plowing is practiced on sloping land. Farmers plow across a slope, instead of up and down. The plowed soil forms ridges across the slope. The ridges help slow the flow of rain water.

Strip cropping also helps slow the flow of rain water down a slope. Farmers plant grass, clover, or other close-growing plants in strips between bands of corn, wheat, or other grain crops. Grass and clover hold water and protect the soil better than grain crops do.

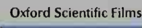
Terracing helps prevent soil erosion on hillsides. Farmers build wide, flat rows called *terraces* on the hillsides. A terraced hillside resembles a large staircase. The terraces hold rain water and so prevent it from washing down the hillside and forming gullies.

Minimum tillage, also called *conservation tillage,* consists of several methods of reducing the number of times a field must be tilled. Normally, farmers till their fields three or more times each growing season. One form of minimum tillage is called *zero-tillage* or *no-till.* After harvesting a crop, farmers leave the *residues* (remains) from the crop on the field as a covering for the soil, instead of plowing them under. During the next planting, the farmer prepares the seedbed with a device that leaves the residues between the crop rows. Zero-tillage not only provides cover for the soil but also conserves tractor fuel.

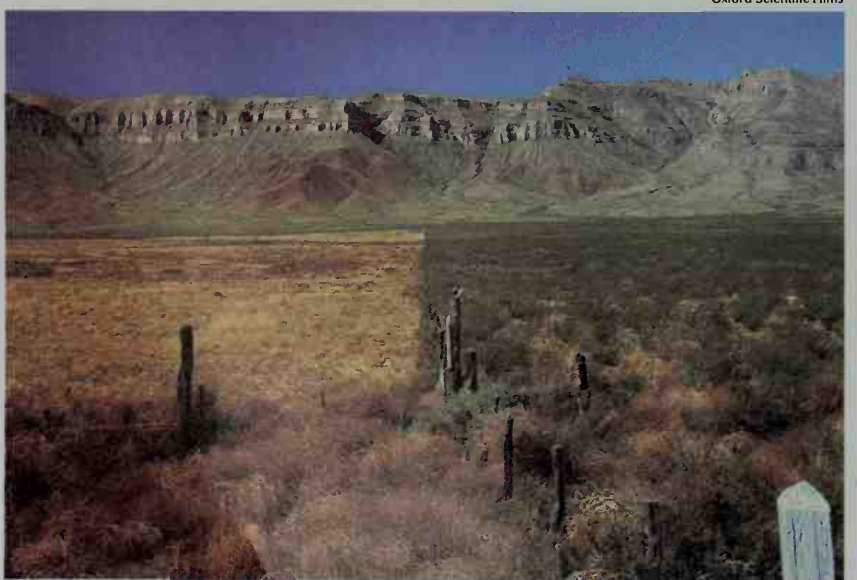
Another major conservation problem on farmlands is declining soil fertility, which is caused partly by planting the same crop in a field year after year. Corn, wheat, and other grain crops drain the soil of an essential chemical called *nitrogen* if they are grown on the same field for several years. Farmers can maintain the fertility of the soil by practicing *crop rotation,* in which crops are alternated from year to year. The rotation crop is usually a *legume,* such as alfalfa or soybeans. Unlike corn and wheat, legumes restore nitrogen to the soil.

Some farmers add plant remains or *manure* (animal wastes) to their fields to enrich the soil. Many use chemical fertilizers for this purpose. Excessive use of some chemical fertilizers, however, may decrease the ability of bacteria to decay humus and produce nutrients naturally. As a result, the soil may gradually harden and lose much of its ability to absorb rain water. The soil then erodes more easily. In addition, the chemicals from fertilizers may wash out of the soil and enter lakes, streams, and even wells, polluting the water. Excessive use of pesticides causes similar problems.

A common problem on irrigated farmland is the build-up of various chemical salts in the soil. Most irri-



Oxford Scientific Films



Grazing lands provide pasture for livestock. But improper management may result in overgrazing, which destroys the vegetation on the land. In this picture, the land on the left has been overgrazed, and the land on the right has been properly grazed.



Steve Bunting

Prescribed burning is one way to improve the vegetation on overgrazed land. The fire destroys weeds and other undesirable plants, and grasses can then regrow.

gation water contains small amounts of these salts. In time, the salts accumulate in the soil and may reduce plant growth and ruin cropland.

Conservation of grazing lands. Grazing lands, also called *ranges,* are grass-covered areas too dry to support farms or forests. These lands provide homes for many wild animals, including pronghorns and mule deer. Numerous grasses and such flowering plants as goldenrods and sunflowers grow there. Ranges also provide pasture for cattle, horses, and sheep. Some of the world's largest grazing lands lie in western North America, southern South America, and Australia.

The chief conservation problem on ranges is overgrazing, which results when too many animals graze an area or when the animals stay in one place too long. The grasses then die and are replaced by weeds and poisonous plants, which provide poor pasture for livestock.

Overgrazing also results in increased runoff of water, which causes soil erosion. Overgrazing also ruins wildlife habitats. For example, it often occurs on the fertile areas that border a stream. Livestock trample on stream banks and kill plant life. This results in increased erosion along the stream bank and may cause the stream to become too muddy to support fish and other aquatic life.

Grazing lands, many of which are owned by national governments, must be carefully managed to ensure a continuous supply of *forage* (plant food) for wildlife and for livestock. To prevent overgrazing, range conservationists must determine the *carrying capacity* of the land. The carrying capacity is the largest number of animals that an area of land can support without destruction of plant life. Range conservationists limit the number of livestock on a range so that the carrying capacity is not exceeded. Livestock managers must move the herds from time to time so that the grasses can regrow.

To improve the vegetation on grazed lands, range managers sometimes practice *prescribed burning.* That is, they set fires to help control brush and poisonous plants. When properly controlled, such burning will not harm native plants. Many of these native plants have become adapted to frequent, low-intensity fires. Herbicides can also eliminate undesirable plants. But many conservationists oppose the use of chemical herbicides because the chemicals in them may harm animals.

Another problem on grazing lands is the control of such animals as bobcats, coyotes, and mountain lions, which sometimes prey on livestock. Many ranchers want these predators killed or removed. But most conservationists want to protect the animals.

Forest conservation. Forests serve as sources of timber and as habitats for many animals and plants. They also provide recreational areas for campers, hikers, and hunters. In addition, forests are important as watersheds. They absorb large amounts of rain water, preventing the rapid runoff of water that causes erosion and flooding.

Many forests are owned by national governments. In the United States, the U.S. Forest Service manages these national forests under the principle of *multiple use,* which means they provide several benefits at once. For example, the Forest Service manages woodlands to furnish timber, shelter wildlife, provide recreational space, and conserve water. Timber production, however, may conflict with the need to conserve wildlife, water, and other resources. Also, the use of prescribed burning in forests, often done to maintain native species that are adapted to frequent fires, can conflict with concern over smoke and the danger of fire in adjacent areas.

The conservation of forests used to produce timber depends on replacing trees that are cut down so that the forest has a *sustained yield.* Sustained yield is an approximate balance between the annual harvest and the annual growth of wood. The Forestry article in *World Book* describes methods of harvesting trees to achieve sustained yield. It also describes how forest resources other than trees are managed and how forests are protected from diseases and insect pests.

For centuries, people have cut down forests to clear land for farms and cities. Today, forest destruction in the United States and other industrialized countries has



© David Parker/SPL from Photo Researchers

Recycling is an important conservation activity. Workers at this waste transfer station remove plastics and other recyclable materials from household trash. Industries then reuse the materials.

slowed, though many forest-dwelling species remain threatened. In many other countries, however, especially those in tropical areas, forest destruction continues at a rapid pace. The reduction of tropical rain forests has put at risk the survival of the richest and most diverse ecosystems in the world.

Mineral conservation. Minerals include such substances as copper, gold, iron, lead, and salt. Industries use minerals to manufacture countless products.

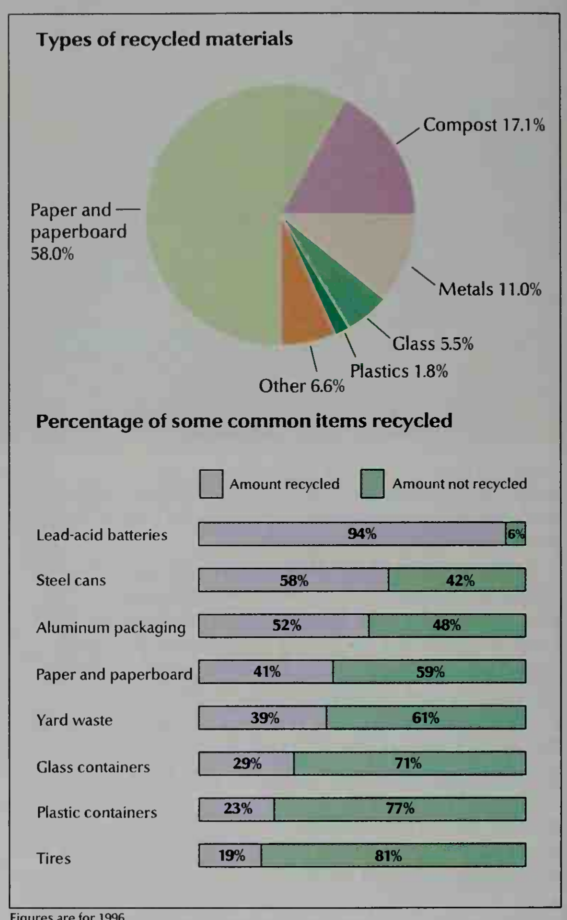
The use of many minerals has increased greatly throughout the world. The use of aluminum, for example, has increased about five times since 1960. The use of nickel has more than doubled during this period. Some minerals, such as *bauxite* (the mineral from which aluminum is obtained) and salt, are plentiful. But the proved reserves of such minerals as copper, lead, nickel, and zinc may be depleted within 100 years.

Mining companies can profitably extract most minerals only where they occur in large deposits. Industries first develop the highest-grade and most easily minable ores. When these are depleted, mining companies turn to lower-grade and harder-to-mine ores. Many such deposits require advanced technology and large amounts of energy to mine. Some take so much energy to mine and refine that they cannot be profitably developed.

Deposits of minerals are unevenly distributed around the world. This uneven distribution of minerals has played a major role in history. For example, the ancient Romans battled the Celts for control of the tin mines in

Materials recycled in the United States

Recycling is a way to conserve important resources. This pie graph shows the substances that make up the total amount of recycled materials in the United States. The bar graph shows the percentages of various discarded items that are recycled.



Figures are for 1996.
Source: U.S. Environmental Protection Agency.

southern England. A desire for gold was largely responsible for the Spanish explorations and conquests of many parts of the New World.

The need for minerals continues to influence international relations today. Many countries must import large amounts of various minerals. The United States, for example, imports almost all of the sheet mica and strontium it uses. In addition, the United States imports more than half of its chromium, cobalt, fluorine, manganese, nickel, platinum, and tin.

Mining and refining minerals often destroys scenic lands and habitats for animals and plants. It can also pollute air and water. One method of copper mining, for example, leaves large open pits on the surface of the land. Fumes from copper smelters, iron and steel mills, and other refineries pollute the air and kill many plants. Some refineries discharge wastes in lakes and streams.

We can conserve minerals in a number of ways. Industries can reduce waste by using more efficient mining and processing methods. In some cases, industries can substitute plentiful materials for scarce ones. Some

mineral products can be recycled. Aluminum cans are commonly recycled. Although bauxite is plentiful, it can be expensive to refine. Recycling aluminum products does not require the large amounts of electric power needed to refine bauxite. Products made from many other minerals, such as nickel, chromium, lead, copper, and zinc, can also be recycled.

Energy conservation. All industries require energy to operate. Energy is also used in transportation and recreation. In addition, we use energy to warm and cool our homes, to cook food, to provide lighting, and to operate many appliances.

About 95 percent of the energy used throughout the world comes from oil, coal, and natural gas. These substances are called *fossil fuels* because they developed from fossilized remains of prehistoric plants and animals. Large deposits of fossil fuels take millions of years to form. The earth has a limited supply of fossil fuels. But the worldwide use of fossil fuels has nearly doubled every 20 years since 1900. As the supply dwindles, the cost of fossil fuels keeps rising.

Many nations are working to develop other sources of energy to reduce their dependence on fossil fuels. But every source of energy has some disadvantages that make its development difficult. The **Energy supply** article describes such sources of energy as nuclear energy, solar energy, and geothermal energy.

Until other sources of energy are further developed, nations must conserve fossil fuels to make the supply last as long as possible. Most of the responsibility for conservation rests with industrialized nations because they consume the majority of the world's energy. The United States alone uses about 25 percent of the world's energy, and it produces only about 20 percent. Higher fuel prices and periodic fuel shortages have forced the United States and many other industrialized nations to develop better conservation programs.

Industries and individuals can conserve energy in many ways. Improved mining and manufacturing techniques can make the industrial use of fuel more efficient.



Steve Hale

Urban conservation includes efforts to restore houses and so maintain the attractiveness of old neighborhoods in cities.

Individuals can save fuel in their homes by installing insulation, which reduces the amount of fuel used for heating and air conditioning. People can set their thermostats at or below 68 °F (20 °C) in winter and at or above 78 °F (26 °C) in summer. These thermostat settings

© Bruce M. Wellman, Tom Stack & Associates



Solar collectors can be used to help heat houses and many other buildings. The development of new energy sources reduces our dependence on the dwindling supplies of fossil fuels.

are required in most public buildings by the federal government. People can also conserve energy by using less hot water and turning off unnecessary lights. Motorists can save gasoline by driving smaller cars and by forming car pools. Much gasoline would be saved if more people used public transportation.

The development and use of energy causes many environmental problems. For example, strip mining of coal destroys plant life and exposes the land to erosion. Blowouts of offshore oil wells and leaks from tankers produce oil spills that pollute the oceans. The burning of fossil fuels pollutes the air and results in the formation of *acid rain,* rain and other precipitation polluted mainly by sulfuric and nitric acid. Acid rain can kill fish in lakes and streams. Sound conservation practices, such as restoring strip-mined land as closely as possible to its original condition, can help reduce environmental damage.

Urban conservation. About half of the world's people live in or near cities. Since the 1800's, many cities have grown so rapidly that public services have not kept up with population increases. Cities thus have such problems as overcrowding, traffic jams, and inadequate public transportation. Most large cities are also noisy and suffer from air pollution, partly because of the many motor vehicles in use. In addition, many cities lack sufficient parks and other recreational facilities. The urban landscape consists largely of pavement and buildings.

Because of the drawbacks of city life, many people and businesses have moved to the suburbs. As suburbs nearest the city become crowded, people move farther and farther out, creating a condition known as *urban sprawl.* When businesses and upper- and middle-class people move to the suburbs, the cities lose tax money needed to maintain city services and neighborhoods. Many cities are left with a large population of poor people living in crowded, run-down housing. The hearts of many cities consist of large slum areas, a condition known as *urban blight.* In addition, much prime farmland has been lost to urban sprawl, and wildlife habitat has been damaged.

The goal of urban conservation is to improve the quality of life in cities and to make them more attractive and pleasant places to live. Many cities have *urban renewal projects,* which demolish run-down buildings and replace them with public housing or other developments. In some cities, developers restore old houses and apartment buildings instead of tearing them down. Many cities try to enhance their environments by developing strips of grass or trees called *greenbelts.* Some cities try to reduce traffic problems and air pollution by improving public transportation systems and encouraging their use. Most cities also need to develop more parks and recreational facilities.

Early history of conservation

Prehistoric times. During early prehistoric times, there were not enough people on earth to use a large amount of natural resources or to damage the environment significantly. Early prehistoric people thus had little need to practice conservation.

About 1 $\frac{1}{2}$ million years ago, people learned how to make fire. They built fires to cook food, to keep warm, and, later, to kill animals. The fires drove the animals over cliffs or into traps. In addition, people have used fire for thousands of years to clear forests and encourage the growth of food plants. Some scientists believe Africa's *savannas* (grasslands with widely scattered trees and shrubs) resulted from burning of forests.

The rise of civilization. A number of civilizations arose around the Mediterranean Sea from at least 3500 B.C. to the A.D. 400's. Many people of the region tended large flocks of sheep and goats, which severely overgrazed the land. In time, the shallow soils of the region eroded. The grassy pastures turned to wastelands, and large areas became desertlike. Much of the land in the Mediterranean region remains in poor condition today.

Although ancient civilizations in the Mediterranean region damaged the land, they also developed some conservation practices to keep farmlands productive. For example, the Phoenicians, whose culture peaked about 1000 B.C., developed techniques of terracing hillsides to prevent soil erosion. The Greeks introduced the practice of crop rotation sometime before the 300's B.C. The Romans, whose empire reached its greatest size in the A.D. 100's, brought knowledge about irrigation practices to the lands they conquered. Many conservation techniques later spread to northern Europe and formed the basis for wise land management there.

The Industrial Revolution was a period during the 1700's and early 1800's when industrialization developed in western Europe and the northeastern United States. During this period, power-driven machines were invented and factories were organized. Machine-made goods produced in factories replaced handmade goods produced at home. Manufacturing, mining, and construction industries expanded rapidly. The Industrial Revolution resulted in increased production of many kinds of goods. It changed most Western nations from rural, agricultural societies to urban, industrial societies. It also brought many environmental problems.

During the Industrial Revolution, burning coal provided power for factories and to heat homes. As a result, smoke and soot polluted the air over London and other industrial cities. Iron smelting and other industries dumped wastes into lakes and rivers. The crowded cities also discharged large amounts of raw sewage into the water. Power-driven machines and improved tools increased people's ability to change the environment. They dammed rivers, cleared thick forests, turned vast prairies into cropland, and drained marshes.

During and after the Industrial Revolution, wildlife and native plant populations decreased rapidly. With improved guns and traps, commercial hunters killed many animals. As more and more people traveled to new lands, they brought animals, plants, and disease organisms that harmed native species, especially on islands. Rats escaped from ships and preyed on birds and their eggs. Goats, sheep, and other livestock overgrazed land, destroying the food supply of wild animals. Introduced Asian and European plants replaced native American grasses that could not tolerate overgrazing by livestock. Wildlife habitats were destroyed as people cleared forests and drained marshes. Habitat destruction dramatically reduced wildlife populations, and it continues to be the major threat to wildlife. Since 1600, more than 400 species of animals have become extinct, and many more have dwindled in number.

Conservation in the United States

Early conservation problems. When the European settlers came to North America, they found a vast land rich in natural resources. But they had to struggle to provide food and shelter for themselves. They regarded nature as a force that they had to fight and conquer. They cleared forests to provide logs for cabins and to establish farms. But most settlers did not follow sound agricultural practices. When the soil eroded or lost its fertility, they moved on to new lands. The settlers had little concern for conservation because they thought the frontier extended so far that it would last forever. Although many colonies passed hunting laws to conserve game animals, the laws were not well enforced.

In the early 1800's, such explorers as Meriwether Lewis and William Clark helped open up the western United States. Many people believed that an unlimited supply of natural resources awaited use by the young nation. Trappers came to hunt animals for their furs. Beaver skins were especially valuable during the 1800's because men's hats were made from the fur. Trappers believed the supply of beavers was inexhaustible, and they trapped too many of the animals. They then had to travel farther west to find more beavers.

The millions of *bison* (American buffalo) that roamed the plains represented another valuable resource. Their hides made warm robes, and their bones were used in fertilizer. During the late 1800's, commercial hunters slaughtered millions of bison. By 1889, only 541 bison could be found alive in the United States. Only the enforcement of game laws and other protective measures saved the bison from extinction. By 2000, the population had grown to about 300,000.

Such careless misuse of many of the country's natural resources aroused some people to the need for conservation. The first national park in the world—Yellowstone National Park—was established in 1872 to preserve the area's unusual natural features and scenic beauty. American naturalists, including John James Audubon, Henry David Thoreau, George Perkins Marsh, and John Muir, promoted conservation measures. Audubon's paintings of birds and other animals aroused public interest in the nation's wildlife. In his book *Walden* (1854), Thoreau discussed his belief that people should live in harmony with nature. Marsh wrote *Man and Nature* (1864), one of the first textbooks to discuss ecology and conservation. It was later retitled *The Earth as Modified by Human Nature*. Muir influenced Congress to establish Sequoia National Park and Yosemite National Park.

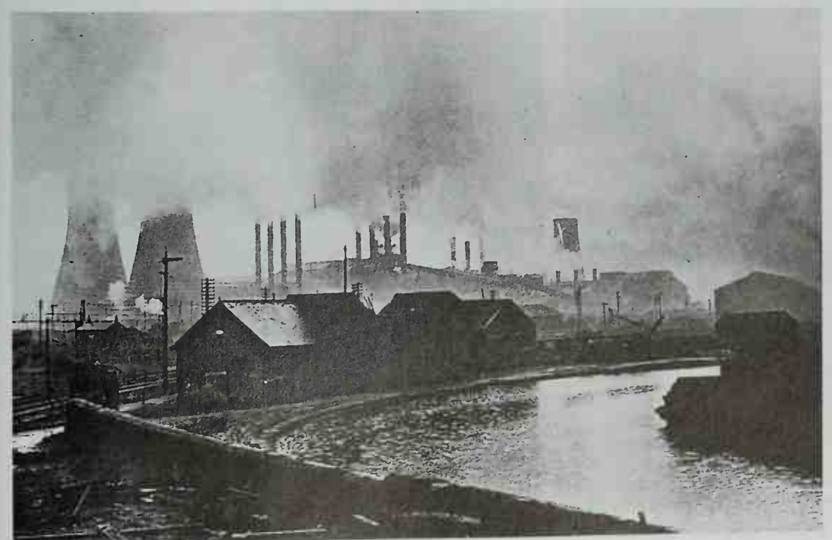
The rise of the conservation movement. During the early 1900's, conservation began to develop as a national movement. Its dominant theme was the wise use of natural resources, including plants and animals, for human benefit. The federal government took many steps to preserve these resources, and conservationists sought to avoid waste at all cost. Throughout this period, however, people considered plants and animals primarily as instruments to increase human welfare, rather than as independent species with their own rights.

Congress passed a conservation law called the Lacey Bird and Game Act of 1900. The act, named for its sponsor, Representative John F. Lacey of Iowa, made it a federal crime to transport illegally killed animals across state borders. It also set controls on the trade in bird feathers, the importation of animals, and the commercial killing of game.

President Theodore Roosevelt made many important contributions to the conservation movement. In 1903, he established the first federal wildlife refuge at Pelican Island, Florida. At the urging of Gifford Pinchot, the head of the U.S. Forest Service, and other conservation leaders, Roosevelt added more than 140 million acres (57 million hectares) to the nation's forest reserves.

In 1908, President Roosevelt brought together governors, federal officials, scientists, business executives, and conservation leaders for a White House conference to adopt national policies for the use of natural resources. The conference approved the principle of multiple use in the management of national forests and parks. The principle of multiple use provided that public lands be managed to serve many benefits. It thus pro-

Corbis/Bettmann



Serious pollution problems accompanied the development and spread of the Industrial Revolution during the 1700's and early 1800's. The air in Sheffield, England, *pictured here,* and many other cities became clouded with smoke and soot from coal-burning factories.



Kansas State Historical Society, Topeka

The slaughter of buffaloes for their hides almost resulted in the extinction of the animal in the United States in the late 1800's. Buffalo hides awaiting shipment east were piled high at Dodge City, Kansas, *shown here.* Strict conservation measures were required to save the buffalo from extinction.

tected these lands from being used solely or primarily for commercial development.

The 1908 conference had far-reaching effects. Within a few years, 41 governors established conservation commissions in their states. The National Conservation Commission was formed, and Gifford Pinchot became its chairman. The commission made the first inventory of the nation's natural resources. Based on the commission's recommendations, President Roosevelt later set aside some public lands as natural resource reserves to be used for scientific studies. In 1911, Congress passed the Weeks Act, named for its sponsor, Representative John W. Weeks of Massachusetts. The Weeks Act formally established the policy of multiple use in the management of national forests and other public lands.

Many conservation projects were begun during the Great Depression of the 1930's, partly to provide jobs for the unemployed. In 1933, President Franklin Roosevelt formed the Civilian Conservation Corps (CCC). Workers in the CCC planted trees, fought forest fires, made paths in national forests and parks, and built dams to control floods. Also in 1933, Congress established the Tennessee Valley Authority (TVA) to conserve the resources of the Tennessee Valley. The region suffered from serious soil erosion and from flooding. The TVA planted trees to restore the region's forests. It built several large dams to control flooding and to provide cheap electric power to rural areas.

The tragedy of the Dust Bowl in the early 1930's dramatized the need for soil conservation in the United States. The Dust Bowl was the name given to parts of the Great Plains where windstorms carried away the topsoil. A severe drought and poor farming and ranching practices had damaged the land. The Dust Bowl covered about 50 million acres (20 million hectares). Many farm families suffered great hardships and had to leave the area. In 1935, President Franklin D. Roosevelt established the Soil Conservation Service to promote soil conservation practices among farmers and ranchers.

In 1937, Congress passed the Federal Aid in Wildlife Restoration Act, which levied a federal tax on sporting arms and ammunition. The federal government distributes tax money to the states for use in wildlife management and research.

Aldo Leopold, an American naturalist, was one of the most influential leaders in the conservation movement during the mid-1900's. He wrote *Game Management* (1933), the first textbook on wildlife management. Leopold promoted the active management of wildlife.

Renewed interest in conservation. The 1960's and 1970's brought renewed interest in conservation. Scientific discoveries about various forms of pollution had a major impact on the conservation movement during the 1960's and 1970's. Rachel Carson, a marine biologist, wrote about the destructive effects of DDT and other pesticides in her book *Silent Spring* (1962). She pointed



Corbis/Bettmann

Vast areas were set aside as national parks during the late 1800's and early 1900's. Yosemite National Park, *pictured here,* was created largely through the efforts of the American naturalist John Muir, *right,* shown standing with President Theodore Roosevelt, who was also an avid conservationist.



The Civilian Conservation Corps employed workers to plant trees in national forests and to perform various other conservation tasks. President Franklin D. Roosevelt formed the Civilian Conservation Corps in 1933.

Corbis/Bettmann

out that pesticides poison the food supply of wild animals and could also contaminate the food supply of human beings. Beginning in 1972, DDT was gradually phased out.

Publicity about DDT and other pollutants led to increased public concern about environmental health. Membership in conservation organizations rose, and people urged Congress to pass laws to protect the health of the environment.

Congress passed the National Environmental Policy Act in 1969. The act requires that a study called an *environmental assessment* be prepared for all federally funded construction projects or other activities that might affect the environment.

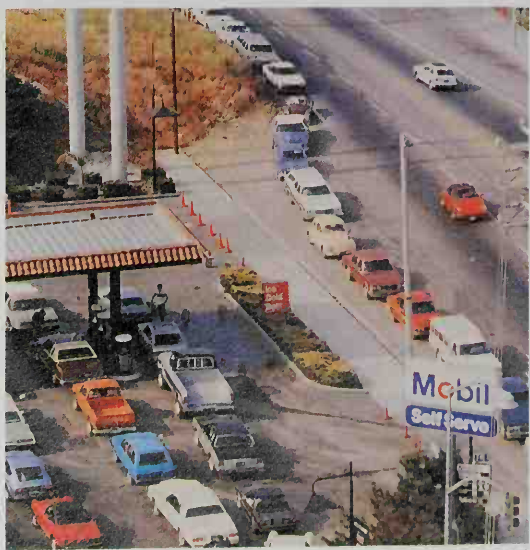
The act also requires preparation of an *environmental impact statement* if experts review the assessment and find the project or activity to have environmental significance. Environmental impact statements are reports that describe how proposed highways, dams, power plants, or other construction projects would affect the environment. Conservationists can use environmental impact statements in court to challenge projects that may be environmentally harmful. In some cases, a court may order that projects be stopped or redesigned to minimize environmental damage.

In 1970, Congress established the Environmental Protection Agency (EPA). The EPA sets and enforces pollution control standards and assists state and local governments in pollution control.

In 1973, Congress passed the Endangered Species Act, which provided more protection for threatened and endangered species of wildlife than earlier laws had. The act prohibits federal projects that would destroy the habitat of an endangered species. In 1978, Congress amended the act to allow exemption of certain projects that serve the best interests of a region or of the nation. In 1995, the Supreme Court of the United States ruled that deliberate destruction of habitat of an endangered species is also prohibited on private property.

During the 1970's, the United States experienced periodic fuel shortages, which led to higher prices for gasoline and home heating fuel. The fuel shortages helped dramatize the need for energy conservation. In 1977, Congress created the Department of Energy, which was given responsibility to develop and promote new sources of energy and ways to save existing supplies.

One project called for the production of synthetic fuels, or fuels that can be substituted for crude oil and natural gas. Synthetic fuels, also called *synfuels,* are gases or liquids produced from coal, *oil shale* (a rock that yields oil when heated), *bituminous sands* (sands that also contain a substance from which oil can be obtained), and *biomass* (organic matter, such as wood, garbage, and animal manure). Synfuels are expensive to make and not widely used. But if oil prices rise greatly,



© Curt Gunther, Camera 5

Fuel shortages in the 1970's forced automobile drivers to wait in long lines at the few stations that had gasoline. The gasoline shortages dramatized the need for energy conservation.

synfuels may become an important energy alternative.

Beginning in the 1970's, private conservation organizations, such as the Nature Conservancy, the World Wildlife Fund, and the Environmental Defense Fund, became more prominent. These organizations publicize the plight of endangered species and the scale of habitat destruction. They also promote conservation legislation in both federal and state governments.

Recent developments. In 1993, Congress established the Office on Environmental Policy. It coordinates environmental policy within the federal government. Such policy increasingly attempts to manage entire ecosystems for the benefit of all the species within them, rather than producing individual management plans for each species as it becomes threatened.

Since the late 1900's, a different kind of conservation philosophy has begun to emerge. Many environmentalists and philosophers now believe that nonhuman species have inherent rights of existence. This movement, foreshadowed in the writings of Henry David Thoreau and John Muir, seeks to give conservation a deeper respect for nature and to make such respect the cornerstone of conservation laws.

Conservation around the world

Many countries have conservation problems similar to those of the United States. Almost all industrialized nations, for example, face such problems as air and water pollution, urban crowding, and shortages of fossil fuels. This section chiefly deals with land management and wildlife conservation in Canada, Latin America, Europe, Asia, Australia, and Africa. It also discusses international conservation problems.

Canada has a large land area and a fairly small population. Most of the people live in the southern part of the country. Canada's interior is only sparsely settled. The country has bountiful supplies of natural resources. Evergreen forests, prairies, and tundra cover much of the country. Canada has many rivers and lakes, most of which are not seriously polluted. The country also has rich deposits of copper, uranium, zinc, and other minerals, many of which lie in remote areas of the interior.

Large areas of Canada remain undeveloped. Thus, many kinds of wildlife are as abundant as they were before the country was settled by Europeans. Canada has plans to develop some of the mineral resources of its interior, however. Unless such development is carefully planned and managed, the growth of the mining industry may result in destruction of wildlife habitats and a decrease in animal populations.

The drainage of wetlands in agricultural areas of Alberta, Saskatchewan, and western Manitoba has destroyed many wildlife habitats. The prairies of these provinces have fertile soil and are intensively farmed to produce cereal grains. Some people want to drain the remaining prairie wetlands, called *prairie potholes,* to increase crop production. But conservationists do not want the wetlands drained because they are important breeding places for ducks and other migratory birds. The wetlands also store runoff water and so help prevent flooding.

Many Canadian forests have been heavily logged. The scale of Canadian *deforestation* (destruction of forests) now compares to that in the United States. Many people in British Columbia and other provinces are greatly concerned about the destruction of original forests and the common practice of *clearcutting* (removing all trees) over large areas.

Canada and the United States have long worked together to protect waterfowl and other wild animals that cross their border. The two countries have treaties that protect migratory birds and other wildlife.

Other issues are not settled, however. Canadians have called for action to prevent the production of harmful chemicals that cross the border in the smoke and other exhausts from U.S. factories. The chemicals mix with water vapor in the atmosphere to form sulfuric and nitric acids. These acids pollute rain, sleet, and snow. The polluted precipitation, commonly called acid rain, kills fish and other wildlife in and around many Canadian ponds and lakes. Most conservationists also believe that acid rain may damage northern forests. They argue that acid rain stops leaves from producing food for trees. Acid rain is thus a major conservation issue in Canada because of its destruction to the environment and the economic hardships it may cause.

Latin America has vast tropical rain forests, where many unique species of plants and animals live. It also has valuable mineral deposits. Mexico, for example, has large deposits of petroleum and natural gas.

Most of Latin America was colonized by the Spanish, who were primarily interested in obtaining gold and other raw materials from the New World. The Spanish generally restricted their settlements to mining centers and areas that had a favorable climate. Thus, until recently, much of Latin America consisted of wilderness areas that were largely undisturbed, though the land around most cities was severely damaged. Parts of Mexico and Central America, however, were more extensively settled and suffered from widespread forest destruction, overgrazing, and soil erosion.



WORLD BOOK photo by Werner Braun

Farming in dry regions requires special techniques to conserve water. The almond tree being hoed by these farmers in Israel is surrounded by a bank of soil that helps retain rain water.



Caring for wildlife is one of many ways people can help conserve the world's biodiversity. This worker is helping an elephant bathe in a wildlife sanctuary in India.

© M. Amirtham, Dinodia

Many nations of Latin America have a rapidly growing population, and most of the people are poor. To raise living standards, a number of countries have begun programs to expand industry and agriculture. The tropical rain forests contain commercially valuable trees, and timber production has increased. Many countries have cut through forests to build roads to reach remote areas where mineral deposits lie. In addition, farmers have cleared forests to provide land for growing crops. The soil of the tropical rain forests, however, does not generally make good farmland. Most tropical soils are not fertile, and few Latin American farmers can afford the large amounts of fertilizers needed to enrich the soil. In addition, tropical soils may harden when they are exposed to direct sunlight. They then become useless for growing crops. As a result, the farmers remove more trees each year to provide new cropland.

The expansion of industry and agriculture in Latin America has thus resulted in destruction of forests and wildlife habitats. Many countries have established national parks to conserve forests and wildlife. But in many cases, the parks are not well protected.

Europe. Much of the land in southern Europe has been severely damaged by the destruction of forests and by overgrazing of livestock. The soil has eroded from hillsides, and the vegetation on grasslands is sparse and of poor quality. Many countries of southern Europe have begun programs to replant trees on hillsides and to improve vegetation on grasslands.

In northern Europe, forests still cover much of the land, and environmental damage is not as great as it is in southern Europe. Northern Europeans were among the first people to recognize the environmental value of trees, and they developed the science of forestry. The forests of northern Europe contain only a few species of trees and a small variety of endangered animals and plants. Thus foresters can clearcut large areas of these forests and still safely replenish them by replanting the same few tree species. Such forestry practices would not work well in environments with greater biodiversity. Northern Europeans also have practiced wildlife conservation for many years. In some countries, much of the land is privately owned, and the landowners take responsibility for protecting wildlife. Most of the countries have also established nature reserves.

Russia, part of which is in Europe and part in Asia, has the world's largest forest reserves. Russia makes considerable commercial use of its forests for logging, and of its wildlife for food and manufactured goods. But the country has also worked to conserve its forests from too much logging and to protect polar bears and other wildlife resources.

Asia has more people than any other continent. Many Asian countries have difficulty conserving natural resources because the land must support so many people.

In Southeast Asia, many forests have been cut down to produce timber and to clear land for farms and industries. The destruction of forests has reduced the living space of wildlife. Much of Asia's wildlife is also threatened by overhunting. Many people kill animals for food or hunt them to sell to zoos, medical researchers, and pet traders. Because of habitat destruction and overhunting, many large Asian animals, including elephants, rhinoceroses, and tigers, have become endangered.

In China, people have cut down most of the forests for wood, which has caused serious soil erosion. The soil is deposited in rivers and streams, which lowers the quality of the water. The Huang He, or Yellow River, is so named because the light-colored soil gives the water a yellowish color. The soil has also raised the riverbed. As a result, the Huang He often floods, causing great property damage and loss of life along its banks.

In the Middle East, deserts cover much of the land. With irrigation, however, farmers have turned some areas into productive croplands. Israel is especially well known for its irrigation efforts. Some farmland in Israel and a number of other countries, however, has been seriously damaged by the build-up of salts in the soil, a common problem on irrigated land.

Australia. Ranges cover much of Australia, and sheep ranching is widespread. In many dry regions, overgrazing has seriously damaged the vegetation.

Australia's wildlife includes numerous species of mammals called *marsupials*. Kangaroos and some other marsupials are grazing animals. They thus compete for food, water, and living space with the sheep that graze on the ranges. Ranchers have killed many kangaroos because they believe the animals reduce the grass supply for sheep. Hunters have also killed many kangaroos for their hides and to sell their meat. Because the Australian government feared that kangaroos might become extinct, it banned the sale of live kangaroos and of kangaroo hides and meat to other countries in 1973.

The control of predators is a major problem. On

ranges, wild dogs called *dingoes* prey on the sheep. Some ranchers have tried to kill the dingoes with poisons. But many conservationists oppose poisoning because they believe it also kills other species of wild animals. Introduced red foxes and cats have devastated populations of native marsupials in much of Australia.

The introduction of European rabbits into Australia during the 1850's created a major conservation problem that continues today. In Australia, these rabbits had no natural predators or diseases to limit their population, and their numbers soared. The rabbits consumed so much forage that many sheep ranchers were forced to reduce the size of their flocks. Australian scientists succeeded in reducing the rabbit population in the 1950's by exposing the animals to a viral disease called *myxomatosis,* which affects only rabbits. But later generations of rabbits developed resistance to this virus. The rabbits again grew in numbers. In the mid-1990's, scientists accidentally released a new viral disease called *calicivirus* that has once more helped limit the number of rabbits.

Africa. In northern Africa, many people live by tending herds of sheep and goats. Along the southern edge of the Sahara, overgrazing has severely damaged much of the land. In these arid areas, the sandy soil quickly erodes after the protective covering of vegetation has been removed. The land then becomes desertlike. Overgrazing and droughts have contributed to the expansion of the Sahara, which advances along parts of its southern border up to 30 miles (48 kilometers) a year.

In central and southern Africa, destruction of habitats and overhunting have reduced wildlife populations. People have overhunted many African species because they prize the animals as trophies and as sources of valuable products. Elephant tusks provide ivory. Craftworkers use much of the ivory to make beads and bracelets. Fur traders prize leopards for their hides, which are used to make expensive fur coats. Many African nations have passed strict hunting laws, but the laws are difficult to enforce in remote areas. The commercial value of elephant tusks, leopard hides, and other animal products on the world market makes *poaching* (illegal hunting) very profitable. In 1989, many nations agreed to end the sale of ivory. But some conservationists believe poaching will continue as long as people buy ivory. To help protect their wildlife, many African nations have established large national parks and nature preserves.

International problems. The United Nations, the IUCN (International Union for the Conservation of Nature and Natural Resources), and other organizations support worldwide conservation programs. The IUCN gathers information on the world's endangered wildlife and publishes the data in its *Red Data Book.* Other international conservation organizations, such as the International Whaling Commission, work to conserve animal, mineral, and other resources in the oceans.

Conservationists are also concerned about the growing level of carbon dioxide in the atmosphere. Carbon dioxide traps heat in a process called the *greenhouse effect.* The amount of carbon dioxide in the atmosphere is increasing chiefly because of the burning of such fossil fuels as coal, oil, and natural gas. The destruction of forests, which absorb carbon dioxide from the atmosphere, also contributes to an increase in this gas. Some scientists believe significant global warming may alter the earth's ecological balance and cause great changes in rainfall patterns and ocean levels. Conservationists are working to replant forests and decrease fossil fuel use.

Careers in conservation

Most careers in conservation require a college degree. Many people with an interest in the outdoors pursue a career in forestry, wildlife ecology, or soil conservation. Others work in conservation education, urban planning, or various other fields.

Conservation biologists work for government agencies, private conservation organizations, and universities. They study the full range of ways in which living species are threatened, as well as the status of biodiversity worldwide. They also work toward the protection, management, and restoration of biodiversity.

Forestry is one of the oldest conservation professions. Foresters are employed by national and local governments, as well as by logging companies. Some foresters specialize in *silviculture,* the science of growing trees. Others work in such areas as watershed management, insect and disease control, or timber harvesting.

Wildlife biologists may work in national wildlife refuges, nature reserves, rangelands, forest reserves, fish hatcheries, or government agencies responsible for wildlife management. In addition, private consulting firms employ wildlife biologists to prepare environmental impact statements. Many land development companies employ people with wildlife management training.

Soil conservationists are employed by various government agencies to promote the wise management of plant, soil, and water resources. Many agricultural specialties, including *agronomy, range ecology,* and *soil physics,* deal with resource management.

Urban planners and urban geographers work with regional or city planning agencies. These agencies work to improve city services. They also plan urban renewal projects and other city development programs.

Geologists, civil engineers, and scientists in many fields contribute to conservation. They conduct research and seek solutions to many conservation problems, including pollution control and the development of new energy sources. Daniel Simberloff

Related articles in *World Book* include:

Soil and water conservation

Coal (Strip mining)
Cropping system
Dam (What does a dam do?)
Drainage
Erosion
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Ground water
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Land Management, Bureau of
Reclamation, Bureau of
Sewage
Shelterbelt
Soil
Tennessee Valley Authority
Water
Water pollution
Wetland
World Health Organization

Forest and wildlife conservation

Animal (The future of animals)
Arbor Day
Biodiversity
Bird (Bird study and protection)
Endangered species
Fish and Wildlife Service
Fishing industry (Fishery conservation)
Forestry
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Park
Urban renewal
Waste disposal

Conservation organizations

Audubon Society, National
Greenpeace
Izaak Walton League of America
National Wildlife Federation
Nature Conservancy
Sierra Club
World Wildlife Fund

Conservation leaders

Adamson, Joy
Audubon, John James
Carson, Rachel
Commoner, Barry
Darling, Ding
Elton, Charles Sutherland
Fossey, Dian
Leopold, Aldo
Miner, Jack
Mowat, Farley
Muir, John
Pinchot, Gifford
Roosevelt, Theodore

Other related articles

Agriculture, Department of
Balance of nature
Earth Day
Ecology
Environmental impact statement
Environmental pollution
Environmental Protection Agency
Food supply
Interior, Department of the
Natural resources
Recycling

Outline

I. The importance of conservation
- A. To meet demands for resources
- B. To maintain the quality of life

II. Kinds of conservation
- A. Biodiversity conservation
- B. Water conservation
- C. Ocean conservation
- D. Soil conservation
- E. Conservation of grazing lands
- F. Forest conservation
- G. Mineral conservation
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- I. Urban conservation

III. Early history of conservation
- A. Prehistoric times
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IV. Conservation in the United States
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VI. Careers in conservation

Questions

What percent of the world's energy does the United States consume? What percent does it produce?
Why is conservation important?
Why did the settlers of North America have little concern for conservation?
What is *watershed management*?
How can individuals conserve energy in their homes?
What are environmental impact statements?
How can farmers reduce soil erosion?
What is the goal of urban conservation?
How have people harmed the world's oceans?
What is the major threat to wildlife today?

Additional resources

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Conservation of matter, Law of. See Mass.
Conservation of momentum. See Momentum.
Conservation of parity. See Parity (in physics).

Conservatism is an attitude or philosophy that places great emphasis on tradition. Conservatives want to *conserve* (save) traditional institutions, values, and ideas, and they rely on them as a guide to wisdom and goodness. Therefore, they seek progress in line with proven values of the past. But the word *conservatism* is confusing because its meaning varies with time, place, and circumstance.

Political conservatism. Political conservatives take a limited view of what politics can achieve. They believe that the aim of politics, or government, is to help promote a good life for people in society. Most conservatives, however, doubt that the good life can be brought about mainly by political means. They believe that all political problems are basically moral problems, and that legislation cannot significantly change human attitudes. Conservatives believe that the human potential for evil is as great as the potential for good. They doubt that evil will disappear with social reform or education.

Conservatives emphasize the performance of duties as the price of rights. They also believe in the desirability of maintaining social classes. Conservatives believe that all people have equal protection under the law, but they deny that all are born with equal advantages and influence in society. Conservatives maintain that only a few are natural leaders, and that the leadership provided by these few is essential to social order. For these reasons, conservatives consider political and economic leveling foolish and bound to fail.

Conservatives see a link between freedom and private ownership of factories and other means of economic production. They maintain that abolishing such private ownership would destroy individual liberty. Therefore, many conservatives believe that socialism and Communism are the greatest threats to modern society.

History. As early as the 1700's, the British statesman Edmund Burke expressed conservative ideas in his writings and speeches. Early conservatives in the United States included John Adams and Alexander Hamilton. The name *Conservative* was first used around 1830, applied to the descendants of the old British Tory Party. The words *Tory* and *Conservative* are used interchangeably in the United Kingdom today. Conservatism arose partly as a reaction to the excesses of the French Revolu-

tion and the belief that human nature could be perfected through social change and political revolution. Conservatives argued that social change must occur within the framework of traditional ideas and institutions.

A true conservative should also be distinguished from a *reactionary.* Reactionaries want to revolutionize existing society according to a model in past history. True conservatives are never revolutionary. They want to preserve the best in the past and continue it into the future.

The word *conservative* as used in the United States today is often confusing. Many Americans who call themselves conservatives advocate a return to the principles and theories of liberalism of the 1800's. They oppose almost all government regulation of the economy, and are economic liberals in the tradition of Adam Smith. Traditionally, however, conservatives have opposed both economic liberalism and socialism. They have tried to steer a middle course between the extremes of individualism and collective ownership, and have generally favored a strong central government.

Today, many U.S. conservatives believe that economic and social problems are solved best when government interference in the economy is kept to a minimum. They also believe that the need to protect society justifies some restriction of the rights of people accused of crime. Some conservatives oppose abortion, and some support state-sponsored prayer in public schools. In foreign policy, U.S. conservatives tend to regard military power as the basis of world peace. Carl L. Davis

See also **Christian Coalition; Conservative Party; Judaism** (Conservative Judaism); **Liberalism; Right wing.**

Conservative Party is one of the two main political parties in the United Kingdom. The other is the Labour Party. Historically, the Conservative Party took the place of the Tory Party that appeared in England during the late 1600's and flourished until the middle 1800's.

Benjamin Disraeli, a founder of the Conservative Party, worked for a new program for the Conservatives. He wanted the working class given the right to vote. Disraeli also sought to pass social legislation in favor of the workers, and he worked for stronger bonds between the United Kingdom and its empire. Disraeli succeeded in "educating" his party. Conservatives passed the Reform Act of 1867, increasing the number of working-class voters. After World War I (1914-1918), Conservatives helped reorganize the British Empire to achieve equality between the United Kingdom and the dominions. Winston Churchill, a Conservative, led a coalition government during most of World War II (1939-1945). In July 1945, near the war's end, the coalition ended. The Labour Party was elected to power.

The Conservative Party governed again from 1951 to 1964, and from 1970 to 1974. In 1975, the Conservatives elected Margaret Thatcher as leader of the party. Thatcher became the first woman to head a British political party. In 1979, the Conservatives won control of the government, and Thatcher became the United Kingdom's first female prime minister. Under her leadership, the Conservatives won the 1983 and 1987 elections. John Major succeeded Thatcher as prime minister and Conservative Party leader in 1990. The Conservatives retained control of the government by winning national elections in 1992. But in 1997 elections, the Labour Party won by a landslide, and Labour Party leader Tony Blair succeeded Major as prime minister. Labour kept control of the government in 2001 elections. Robert E. Dowse

See also **Disraeli, Benjamin; Peel, Sir Robert; Tory Party.**

Consolidated school is the result of joining two or more school districts and combining their school populations. This term is generally used in rural or suburban areas. The need for more adequate school facilities in areas where the population is scattered led to the consolidation of independent school districts in many parts of the United States. Often, as many as six districts with inadequate schools have been combined to make two or three larger districts. Such consolidation ensures a more varied curriculum, and better libraries and teaching staffs. Donald H. Eichhorn

Consonant is a letter or sound which in speech requires hindering of the breath by the tongue, teeth, or lips. There are two kinds of sounds. The open sounds with free breath are called *vowels.* The closed sounds, called *consonants,* are made with the breath wholly or partly checked. *Stopped consonants* require complete stoppage of the breath. They are *b, d, g, k, p,* and *t.* Other consonants require only partial stoppage of breath. They are *l, m, n, r, w,* and *y.* The *spirants* are open consonants that require friction in the oral passages. They are *f, s, v,* and *z. H* is an *aspirant,* or *breathed,* consonant. See also **Pronunciation; Vowel.** Susan M. Gass

Consort. See **Prince consort; Queen.**

Conspiracy, *kuhn SPIHR uh see,* is an agreement between two or more people to do something that is against the law. One person cannot conspire with himself or herself. It is usually not necessary that the planned act actually be committed or that any person be defrauded or injured. The act of conspiring constitutes a crime. Each person involved in the conspiracy is criminally responsible for everything that results, whether it was intended or not. Conspiracy is punishable by fines or imprisonment. If loss of human life results from a conspiracy, murder may be charged. George T. Felkenes

See also **Coup d'état.**

Constable, *KAHN stuh buhl,* is a police officer in a rural community of the United States. Constables may arrest people suspected of crime. But their main job is to carry out court orders. The word *constable* comes from the title of an official of the East Roman Empire called the *comes stabuli,* or count of the stable. In France, the constable was once a member of the monarch's household, or a commander of the monarch's armies. In England, all police officers are called constables.
Park Dixon Goist

Constable, John (1776-1837), ranks with J. M. W. Turner as the leading English landscape painter of the 1800's. Constable is known mainly for his paintings of the rural areas near his birthplace and in other parts of southern England. Constable sketched outdoors during the warmer months. During the winter, he worked in his studio and developed the sketches into paintings. Constable emphasized such environmental features as the appearance of the sky and clouds, and the effects of light and shadow on the landscape. He believed such features in a painting reflected nature accurately. Constable's fresh style influenced the impressionist painters of the late 1800's. An example of this style, *Boat-Building near Flatford Mill,* appears in the **Painting** article.

Constable's best-known paintings include *The White Horse* (1819), *The Hay Wain* (1821), and *Stoke-by-Nayland* (1836). Constable used vivid colors in many earlier paintings. After his wife died in 1828, he painted many dark, moody pictures that reflected his depression.

Constable was born in East Bergholt, near Ipswich. In his youth, he began to draw the countryside near his home. A love of his native environment is apparent in all his work. Constable studied at the Royal Academy of Arts, beginning in 1799. He was elected a full member of the academy in 1829. However, during his lifetime he received only limited recognition. Douglas K. S. Hyland

See also **Painting** (The 1800's [picture: *Boat-Building near Flatford Mill*]).

Constance, Lake. See Lake Constance.

Constantine, *KAHN stuhn TEEN* or *kawn stan TEEN* (pop. 808,000), is a trading center in Algeria about 50 miles (80 kilometers) from the Mediterranean Sea. See **Algeria** (map). It lies on a cliff above the Rhumel River. Railroads link Constantine, a grain shipping point, with the nearby ports of Skikda and Annaba. It was named for the Roman emperor Constantine the Great. He rebuilt it in A.D. 313 on the site of Cirta, a city that was destroyed by war. After hundreds of years of Arab, Berber, and Turkish rule, Constantine was captured by France in 1837. France held it until 1962, when Algeria gained independence. Kenneth J. Perkins

Constantine I, *KAHN stuhn TEEN* or *KAHN stuhn TYN* (1868-1923), of Greece was king from 1913 to 1917 and from 1920 to 1922. He succeeded his father, George I, who was assassinated. During World War I (1914-1918), Constantine promoted Greek neutrality. But the Greek prime minister, Eleutherios Venizelos, favored the Allies. In 1916, Venizelos began a revolutionary movement that the Allies supported. Constantine was forced to leave Greece, which entered the war on the Allies' side. His second son, Alexander I, became king. Alexander died in 1920, and the people voted to restore Constantine to the throne. In 1921, Greece went to war against the Ottoman Empire. Greece was defeated, and in 1922, the Greek military forced Constantine to give up the throne. His oldest son, George II, became king. Constantine was born in Athens. See also **Greece** (History).

John A. Koumoulides

Constantine II, *KAHN stuhn TEEN* or *KAHN stuhn TYN* (1940-), of Greece was king from 1964 to 1973. He succeeded his father, Paul I. Constantine began his reign with much support from the Greek people. But conflict soon arose between him and Prime Minister George Papandreou over the extent of royal power, including control of the military. The king manipulated Papandreou into resigning in 1965. During the next two years, Greece experienced increasing social and political unrest. In 1967, the military seized power. Later that year, after trying to overthrow the military, Constantine fled Greece with his family. He went first to Rome and then settled in London. In 1973, Greece's military government declared him deposed. The next year, the Greek people voted to end the monarchy and make Greece a republic. Constantine was born in Psychico, near Athens. See also **Greece** (History). John A. Koumoulides

Constantine the Great, *KAHN stuhn TEEN* or *KAHN stuhn TYN* (275?-337), was the first emperor of the Roman Empire to become a Christian. He is also known as Constantine I. During his reign, Christians regained freedom of worship, and the Christian church became legal. The Eastern Orthodox Churches regard Constantine as a saint. He rebuilt Byzantium (now Istanbul, Turkey), renamed it Constantinople, and made it his capital. He shifted the Roman Empire's strength from Rome to the eastern provinces and thus laid the foundations of the Byzantine Empire.

Constantine made many gifts to the Christian church. He built the first great Christian cathedral, the Lateran Basilica in Rome. He built other famous churches in and near Rome; and in Antioch, Syria (now Antioch, Turkey); Constantinople; and Jerusalem.

Constantine's official name was Flavius Valerius Aurelius Constantinus. He was born in Naissa (now Niš, Yugoslavia). His father, Constantius, became emperor of the western provinces in 305. Constantius died in 306, and his army proclaimed Constantine as successor. The system of shared rule between two senior and two junior emperors, started by Emperor Diocletian in 293, broke down completely. Seven claimants struggled for power. In 312, Constantine attacked Maxentius, his major rival in the west. Constantine later told how a vision before the battle had promised him victory if he fought under the sign of the cross. In another story, he ordered the first two letters of Christ's name in Greek to be marked on his soldiers' shields. With these marks, Constantine's forces defeated Maxentius at the Milvian Bridge on the Tiber River. As a result of his victory, Constantine became a strong supporter of Christianity. But the Arch of Constantine, a pagan monument constructed in Rome about 315, also honors his victory.

In 313, Constantine arranged a partnership with Emperor Licinius, ruler of the eastern provinces. They met in Milan and gave freedom of worship and equal rights to all religious groups. Constantine recognized the Christian church as a legal body with rights to hold property, and returned property that had been seized to Christians. For more than 10 years, Constantine and Licinius divided the empire. In 324, their rivalry resulted in warfare and a victory by Constantine, who then became sole ruler. Constantine made Constantinople his capital and the center of Roman government.

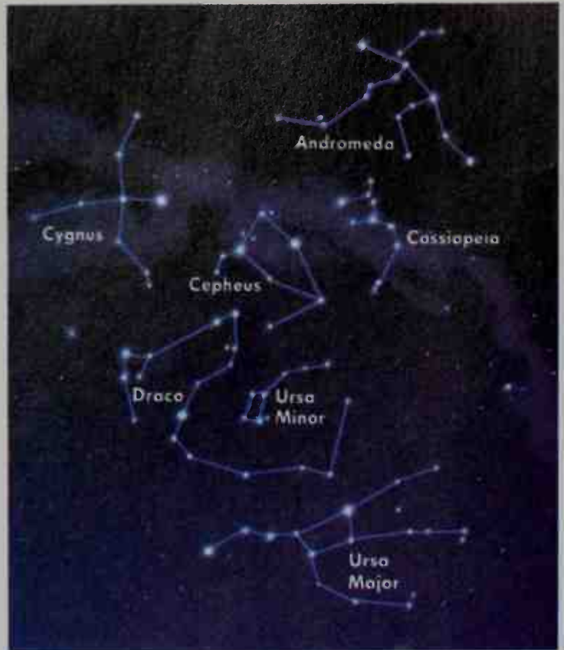
In 325, Constantine presided over the first great *ecumenical* (general) council of the Christian church. The council met in Nicaea, in what is now northwest Turkey, to deal with disputes among Christians, especially with the Arian heresy which considered Christ to have been of a different substance from God. More than 300 bishops from all parts of the empire attended. The council condemned Arianism and drew up a statement of essential beliefs, called the *Nicene Creed* (see Nicene Councils). Constantine was baptized a Christian on his deathbed. The empire was passed to his sons, Constantius, Constans, and Constantine II. Erich S. Gruen

See also **Byzantine Empire** (Beginnings).

Constantinople. See Istanbul.

Constellation, *KAHN stuh LAY shuhn,* is a group of stars visible within a particular region of the night sky. The word *constellation* also refers to the region in which a specific group of stars appears. Astronomers have divided the sky into 88 areas, or constellations.

The ancient Greeks, Romans, and people of various other early civilizations observed groups of stars in the



WORLD BOOK illustration by Rob Wood

Constellations are groups of stars in a specific area of the sky. Each constellation has a Latin name. This map shows 7 of the 88 constellations, all in the Northern Hemisphere.

northern two-thirds of the sky. They named these groups of stars after animals and mythological characters. For example, the constellation Leo was named for a lion, Pisces for two fish, and Taurus for a bull. The constellations Andromeda, Cassiopeia, Orion, and Perseus are named for heroines and heroes in Greek mythology.

Between the early 1400's and the mid-1700's, European navigators explored the Southern Hemisphere and observed many constellations in the southernmost third of the sky. Mapmakers and explorers named these star groups for scientific instruments and other things as well as for animals. For example, the constellation Telescopium was named for the telescope. Musca was named for the fly, and Tucana for the *toucan,* a large-billed bird of Central and South America.

Some well-known groups of stars form only part of a constellation. Such smaller groups are called *asterisms.* For example, the Big Dipper is an asterism that lies in the constellation Ursa Major (Great Bear).

Some constellations can be seen only during certain seasons due to the earth's annual revolution around the sun. The part of the sky visible at night at a particular place gradually changes as the earth moves around the sun. Also, observers at different latitudes see different parts of the sky. An observer at the equator can view all the constellations during the course of a year, but an observer at the North or the South Pole can see only a single hemisphere of constellations. Raymond E. White

Related articles in *World Book* include:

Andromeda
Astrology
Astronomy (Observing the sky; Locating objects in space)
Big and Little Dippers
Cassiopeia
Hercules
Orion
Zodiac

Additional resources

Bakich, Michael E. *The Cambridge Guide to the Constellations.* Cambridge, 1995.
Rükl, Antonín. *Constellation Guidebook.* Sterling Pub., 1998.

Constellation, *KAHN stuh LAY shuhn,* a 38-gun frigate launched in 1797 in Baltimore, Maryland, was the first United States Navy ship to capture a foreign warship. It captured the French frigate *L'Insurgente* on Feb. 9, 1799, during the undeclared war between France and the United States (1798-1800). Thomas Truxtun, who had supervised the construction of the *Constellation,* was the commander. His victories made him a national hero.

In the 1850's, the ship was broken up, and its name was assigned to a newly built 22-gun *sloop-of-war,* a type of small warship. This *Constellation* was the last all-sail warship built by the U.S. Navy. In the mid-1900's, it was put on exhibit in Baltimore. The ship was designated a national historic landmark in 1964. Norman Polmar



Kevin L. Martin

The *Constellation,* the U.S. Navy's last all-sail ship, dates from the 1850's. It is docked in Baltimore and open to the public.

See also Adams, John (picture: Naval battles); Navy, United States (Undeclared war with France).

Constipation, *KAHN stuh PAY shuhn,* is a condition in which the bowel does not rid itself of waste materials in a normal manner. Constipated people do not have regular bowel movements and may have pain or tenderness over the colon. They may suffer from headaches and backaches.

Constipation can be caused by weakness of the bowel muscles or by strong, irregular contractions of these muscles. It may also occur when a person uses laxatives too frequently or does not eat enough of certain kinds of foods, especially those that contain fiber. In addition, constipation may accompany an illness that affects tissues or nerves of the bowel, such as the growth of a tumor that partially blocks the intestines.

When constipation results from a faulty diet, the patient should eat more green vegetables, fruits, whole grain bread and cereals, and other foods with fiber. The patient also should drink ample quantities of water. Constipation may be a symptom of a serious disease. If it

persists, or is accompanied by rectal bleeding, it should be investigated by a physician. André Dubois

See also **Laxative.**

Constitution is a statement outlining the agreed basic principles of formal organizations ranging from national governments to private clubs. It establishes the structure and purposes of the organization and the rights of its citizens or members. It also defines the powers of officers, how they are selected, and how long they can stay in office. Constitutions may also be called *articles of union* or *charters* (see **Charter**).

In Western political philosophy, the principles of constitutional government often have been based on a belief in a *higher law*—a body of universal principles of right and justice that is superior to detailed, everyday law. In modern democracies, a constitution's function is to put everyone—including the rulers—under law.

Government constitutions may be *written* or *unwritten.* The United States has a written constitution. The British constitution is unwritten. It consists of tradition and custom concerning the powers of the monarch, Parliament, and the courts. Many parts of the British constitution were taken from written documents such as the Magna Carta. However, the constitution itself has never been written out in a single document. The British constitution can be modified by Parliament.

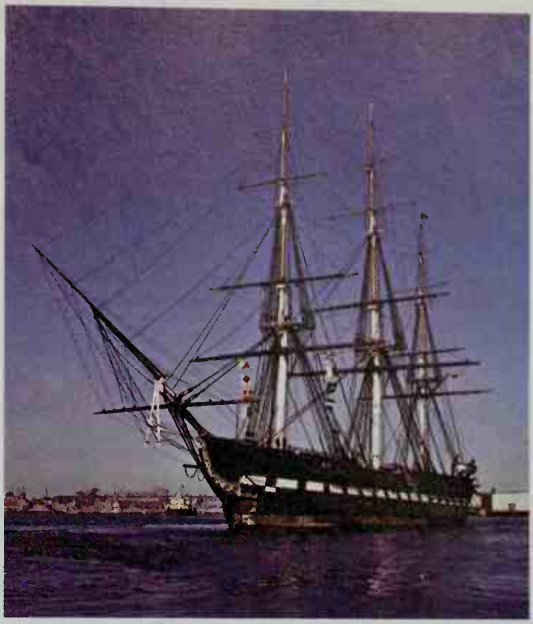
Most modern governments have constitutions based on a single document. In most democracies, the written constitution can be changed only by a special process, such as a special election. Such amending procedures reflect the belief that a constitution should deal with basic principles, and that special deliberation should be required to modify or replace these principles.

Many countries now have nondemocratic or military governments. In these governments, a constitution can be changed by *fiat* (a command or decree) of the ruling group. In such countries, a constitution is more a statement of purpose than a statement defining powers.

In actual operation, constitutions in most democratic countries are unwritten in the sense that the formal document is not the only vital element. Custom and how various governmental bodies interpret the constitution are equally important and sometimes dominant. Under power called *judicial review,* U.S. courts may declare acts of government *unconstitutional* if the acts are considered to conflict with the basic law of the constitution. Most countries have important *nonlegal* rules which do not come from the written constitution or court interpretation. If these nonlegal rules are an essential part of the system of government, they are part of the "constitution" in the broad sense of the term. For example, most aspects of the political party system and the rules for nominating the President in the United States are not specified in the written constitution or subject to court action. Robert G. Dixon, Jr.

See also **British North America Act; United Kingdom (Government); Constitution of the United States; Government; Bill of Rights.**

Constitution is a famous frigate of the United States Navy. Its popular name is *Old Ironsides.* The frigate was built at a Boston shipyard between 1794 and 1797. It was 204 feet (62 meters) long. The hull was made of oak from Massachusetts, Maine, and Georgia, and the masts of white pine. It could carry provisions for a crew of 475.



Calvin D. Campbell, Pictorial Parade

The *Constitution,* better known as *Old Ironsides,* one of the most famous vessels in the United States Navy, is docked at the Charlestown Navy Yard in Boston.

The *Constitution* was launched on Oct. 21, 1797. It was unharmed in battles with the Barbary powers in 1803 and 1804. In the War of 1812, it won a battle near Cape Race against the *Guerrière,* an English warship. During this battle, the ship earned its nickname. A sailor is said to have seen shot from the British guns bouncing off the *Constitution's* sturdy sides, and exclaimed that the ship had sides of iron. Isaac Hull, an American naval officer, commanded the frigate. Following a number of other battles, the *Constitution* was condemned in 1830 as unseaworthy and was ordered destroyed.

The poem "Old Ironsides," by Oliver Wendell Holmes, in which he wrote:

> Oh, better that her shattered hulk
> Should sink beneath the wave,

aroused public sentiment, and the vessel was rebuilt and restored to service in 1833. In 1855, it was put out of commission at Portsmouth Navy Yard and used as a training ship, but was again rebuilt in 1877. In 1897, a hundred years after its launching, the *Constitution* was turned into a barrack ship in Boston.

Between 1927 and 1931, American children raised money to help repair and restore the vessel so it could be preserved as a memorial. In 1930 Congress appropriated $300,000 to complete the work. On July 31, 1931, *Old Ironsides* was commissioned into active service. After sailing 22,000 miles (35,400 kilometers), it returned to the Boston Naval Shipyard on May 7, 1934. The *Constitution,* still in commission, is docked at the Charlestown Navy Yard in Boston. It is the oldest warship afloat in any of the world's navies. James C. Bradford

Constitution Act of 1982. See Canada, Government of (The Constitution).

Constitution of the United States

Constitution of the United States sets forth the nation's fundamental laws. It establishes the form of the national government and defines the rights and liberties of the American people. It also lists the aims of the government and the methods of achieving them.

The Constitution was written to organize a strong national government for the American states. Previously, the nation's leaders had established a national government under the Articles of Confederation (see **Articles of Confederation**). But the Articles granted independence to each state. They lacked the authority to make the states work together to solve national problems.

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After the states won independence in the Revolutionary War (1775-1783), they faced the problems of peacetime government. The states had to enforce law and order, collect taxes, pay a large public debt, and regulate trade among themselves. They also had to deal with Indian tribes and negotiate with other governments.

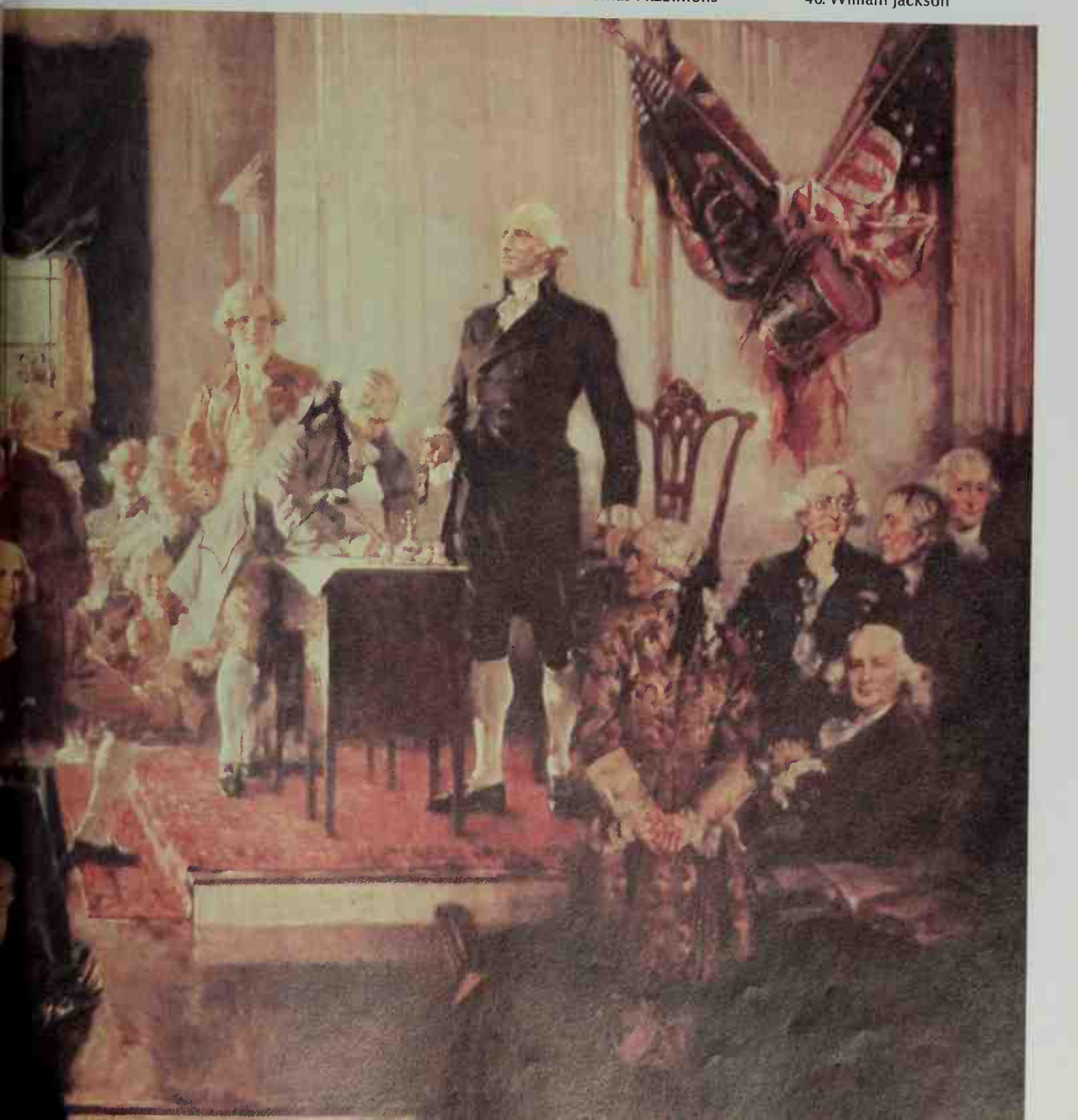
The signing of the Constitution took place on Sept. 17, 1787, at the Pennsylvania State House (now called Independence Hall) in Philadelphia. American artist Howard Chandler Christy painted this picture in 1940. The painting hangs in the United States Capitol in Washington, D.C.

Scene at the Signing of the Constitution of the United States, an oil painting on canvas; U.S. Capitol Historical Society (National Geographic Society)



Signers of the Constitution included William Jackson, who was the secretary of the convention but not a delegate. John Dickinson of Delaware was absent but had another delegate sign for him.

1. George Washington
2. Benjamin Franklin
3. James Madison, Jr.
4. Alexander Hamilton
5. Gouverneur Morris
6. Robert Morris
7. James Wilson
8. Charles C. Pinckney
9. Charles Pinckney
10. John Rutledge
11. Pierce Butler
12. Roger Sherman
13. William S. Johnson
14. James McHenry
15. George Read
16. Richard Bassett
17. Richard D. Spaight
18. William Blount
19. Hugh Williamson
20. Daniel of St. Thomas Jenifer
21. Rufus King
22. Nathaniel Gorham
23. Jonathan Dayton
24. Daniel Carroll
25. William Few
26. Abraham Baldwin
27. John Langdon
28. Nicholas Gilman
29. William Livingston
30. William Paterson
31. Thomas Mifflin
32. George Clymer
33. Thomas FitzSimons
34. Jared Ingersoll
35. Gunning Bedford, Jr.
36. Jacob Broom
37. John Dickinson
38. John Blair
39. David Brearley
40. William Jackson



Ratification of the Constitution

Article VII of the U.S. Constitution required the approval of 9 states to put the Constitution into effect. This table gives the dates on which each of the 13 states ratified the Constitution.

State	Date
Delaware	Dec. 7, 1787
Pennsylvania	Dec. 12, 1787
New Jersey	Dec. 18, 1787
Georgia	Jan. 2, 1788
Connecticut	Jan. 9, 1788
Massachusetts	Feb. 6, 1788
Maryland	April 28, 1788
South Carolina	May 23, 1788
New Hampshire	June 21, 1788
Virginia	June 25, 1788
New York	July 26, 1788
North Carolina	Nov. 21, 1789
Rhode Island	May 29, 1790

Leading statesmen, such as George Washington and Alexander Hamilton, began to discuss the creation of a strong national government under a new constitution.

Hamilton helped bring about a national convention that met in Philadelphia in 1787 to revise the Articles of Confederation. But a majority of the delegates at the convention decided instead to write a new plan of government—the Constitution of the United States. The Constitution established not merely a league of states but a government that exercised its authority directly over all citizens. The Constitution also defined clearly the powers of the national government. In addition, it established protection for the rights of the states and of every individual.

The supreme law of the land

The Constitution consists of a preamble, 7 articles, and 27 amendments. It sets up a *federal system* by dividing powers between the national and state governments. It also establishes a balanced national government by dividing authority among three independent branches—the executive, the legislative, and the judicial. The executive branch enforces the law, the legislative branch makes the law, and the judicial branch interprets the law. The executive branch of the national government is usually represented by the President, the legislative branch by Congress, and the judicial branch by the Supreme Court. This division of the government into three branches is known as the *separation of powers.* Each branch can use its powers to *check and balance* (exercise control over) the other two. See **United States, Government of the** (Separation of powers).

Federal powers listed in the Constitution include the right to collect taxes, declare war, and regulate trade. In addition to these *delegated,* or *expressed, powers* (those listed in the Constitution), the national government has *implied powers* (those reasonably suggested by the Constitution). The implied powers enable the government to respond to the changing needs of the nation. For example, Congress had no delegated power to print paper money. But such a power is implied in the delegated powers of borrowing and coining money.

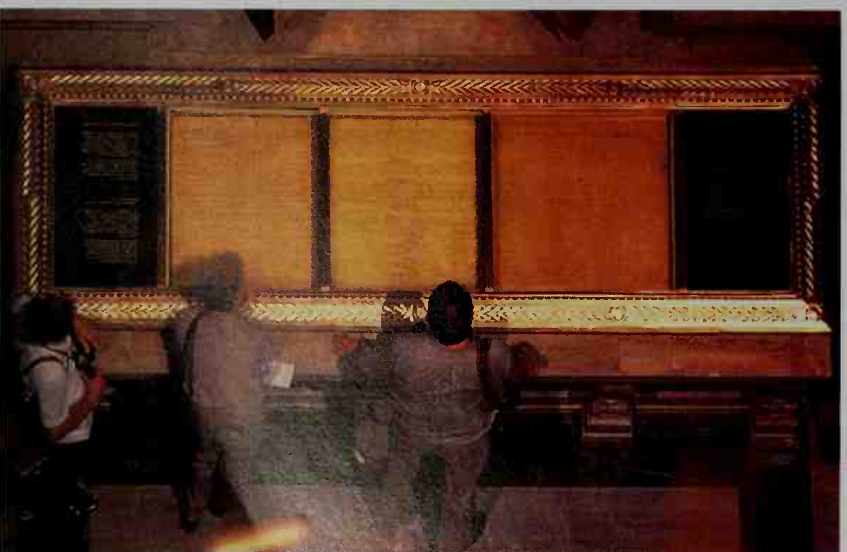
There are some powers that the Constitution does not give to the national government or forbid to the states. These *reserved powers* belong to the people or to the states. State powers include the right to legislate on divorce, marriage, and public schools. Powers reserved for the people include the right to own property and to be tried by a jury. In some cases, the national and state governments have *concurrent powers*—that is, both levels of government may act. The national government has supreme authority in case of a conflict.

The Supreme Court has the final authority to explain the Constitution. It can set aside any law—federal, state, or local—that conflicts with any part of the Constitution.

The need for the Constitution

The government established by the Articles of Confederation was not strong enough to govern the new nation. For example, it lacked an executive branch and a system of national courts. It could not regulate trade between the states or tax the states or their citizens. In


From *The National Archives of the United States* by Herman J. Viola, Publisher Harry N. Abrams, Inc., photographed by Jonathan Wallen



The United States Constitution is on display at the National Archives Building in Washington, D.C. A bronze and glass storage case filled with helium helps preserve the document. The case is lowered into a vault in the floor each night for safekeeping. More than 1 million people view the Constitution each year.

addition, it could not maintain its own army. The government was little more than an assembly of the representatives of 13 independent states. Before almost any measure could be adopted, it had to be approved by at least 9 of the states.

In 1783, after the Revolutionary War, the nation entered a period of unstable commercial and political conditions. Alexander Hamilton and his supporters would have had little success in their campaign for a new constitution if conditions had been better. Some historians have painted the troubles of the new republic in much too gloomy colors. But little doubt remains that the situation became steadily worse after 1783. Each state acted almost like an independent country. Each ran its own affairs exactly as it saw fit, with little concern for the needs of the republic. The states circulated a dozen different currencies, most of which had little value. Neighboring states taxed each other's goods. Britain refused to reopen the channels of trade that the colonies had depended on for their economic well-being. The state legislatures refused to pay the debts they had assumed during the Revolutionary War. Many states passed laws that enabled debtors to escape paying their obligations.

Worst of all, some people began to think once again of taking up arms in order to solve their problems. In western Massachusetts in 1786, hundreds of farmers under Captain Daniel Shays rebelled against the state government in Boston. State troops finally put down Shays's Rebellion (see **Shays's Rebellion**). George Washington and other leaders wondered whether the colonies had rebelled against Britain in vain. They felt it was time to end these troubles and bring peace and order by forming a new national government. This new government would have to be strong enough to gain obedience at home and respect abroad.

Representatives from five states met in Annapolis, Maryland, in 1786. They proposed that the states appoint commissioners to meet in Philadelphia and consider revising the Articles of Confederation (see **Annapolis Convention**). Congress agreed to the proposal and suggested that each state select delegates to a constitutional convention.

The Constitutional Convention

The convention was supposed to open on May 14, 1787. But few of the 55 delegates had arrived in Philadelphia by that date. Finally, on May 25, the convention formally opened in Independence Hall. Twelve states had responded to the call for the convention. Rhode Island refused to send delegates because it did not want the national government to interfere with its affairs.

Of the 55 delegates, 39 signed the United States Constitution on Sept. 17, 1787. One of the signers was John Dickinson of Delaware, who left the convention but



Photri

The Assembly Room of the Pennsylvania State House, where regular sessions of the Constitutional Convention of 1787 were held, is shown as it looks today. The Declaration of Independence was adopted in this room in 1776, and the Articles of Confederation were ratified there in 1781.

asked another delegate, George Read, to sign for him. William Jackson of Philadelphia, a former major in the Revolutionary War who was chosen to serve as the convention secretary, witnessed the signatures. The delegates included some of the most experienced and patriotic men in the new republic. George Washington served as president of the convention. Benjamin Franklin, at the age of 81, attended as a representative of Pennsylvania. The brilliant Alexander Hamilton represented New York. James Madison of Virginia received the title of "Father of the Constitution" with his speeches, negotiations, and attempts at compromise. Madison told the delegates they were considering a plan that "would decide forever the fate of republican government." He kept a record of the delegates' debates and decisions.

Other men who had much to do with writing the new Constitution included John Dickinson, Gouverneur Morris, Edmund Randolph, Roger Sherman, James Wilson, and George Wythe. Morris was given the task of putting all the convention's resolutions and decisions into polished form. Morris actually "wrote" the Constitution. The original copy of the document is preserved in the National Archives Building in Washington, D.C.

Several important figures of the time did not attend the convention. John Adams and Thomas Jefferson were absent on other government duties. Samuel Adams and John Jay failed to be appointed delegates from their states. Patrick Henry refused to serve after his appointment because he opposed granting any more power to the national government. Three leading members of the convention—Elbridge Gerry, George Mason, and Edmund Randolph—refused to sign the Constitution because they disagreed with parts of it.

The background of the Constitution. The delegates to the Constitutional Convention relied greatly on past experience as they worked to create a new government. They recalled many important events in the development of constitutional government. These included the granting of Magna Carta, an English constitutional document, in 1215 and the meeting of the Jamestown representative assembly in 1619 (see **Magna Carta**). Some of the American Colonies also served as examples of constitutional forms of government. While colonial governments had weaknesses, they had progressed beyond other governments of their time in achieving liberty under law.

All American states established constitutional governments after they declared their independence from Britain in 1776. In 1777, John Jay of New York had helped write a constitution for his state. John Adams of Massachusetts had helped write the Massachusetts Constitution of 1780. Delegates to the convention in Philadelphia used many ideas and words from the constitutions of these and other states.

The delegates also drew on their own experiences. Franklin had proposed a plan at the Albany Congress of 1754 to unify the colonies under a central government (see **Albany Congress**). Washington remembered his own problems during the war when, as commander in chief, he had to work with the frequently divided Continental Congress. Almost every delegate to the convention had served as a soldier or administrator of the government. They often disagreed on details but were united in wanting the new government to be strong enough to rule the nation. They also wanted it to respect the liberties of the states and of the people.

The compromises. The task of creating a new government was not easily accomplished. Disputes among the delegates nearly ended the convention on several occasions. For example, delegates from the large states disagreed with those from the small states about representation in the national legislature. The larger states favored the *Virginia Plan,* under which population would determine the number of representatives a state could send to the legislature. The small states supported the *New Jersey Plan,* which proposed that all the states would have an equal number of representatives. The Connecticut delegates suggested a compromise that settled the problem. Their plan provided for equal representation in the Senate, along with representation in



Independence National Historical Park Collection

The silver inkstand shown above is one of the most historic items in the nation. It was used by the signers of the Constitution of the United States in 1787 and by the signers of the Declaration of Independence in 1776.



Photri

The chair used by George Washington during the Constitutional Convention had a carving of a half sun, *above.* On the day the Constitution was signed, Benjamin Franklin expressed a feeling of confidence in the nation's future by declaring that the carving was a "rising and not a setting sun."

proportion to population in the House of Representatives. This proposal became known as the *Connecticut Compromise* or the *Great Compromise.*

Compromises also settled conflicts over the issue of slavery. The delegates from the Northern states wanted Congress to have the power to forbid the foreign slave trade. Most Southern delegates did not wish Congress to have this power. A compromise decided that Congress would not be allowed to regulate the foreign slave trade until 1808. Another compromise involved the question of how to count slaves in determining how many members of Congress a state could have. Slaves were not considered citizens, and so the convention agreed that only three-fifths of a state's slaves could be counted.

The delegates agreed that each state should hold a special convention to discuss and vote on the Constitution. They also decided that as soon as nine states had *ratified* (approved) the Constitution, the Constitution would take effect and they could begin to organize the new government.

Ratifying the Constitution

Less than three months after the Constitution was signed, Delaware became the first state to ratify it, on Dec. 7, 1787. New Hampshire was the ninth state, putting the Constitution into effect on June 21, 1788. But the Founding Fathers could not be sure that the Constitution would be generally accepted until the important states of New York and Virginia had ratified it. Powerful organized opposition to the Constitution had developed in these two states and in others. Such people as Elbridge Gerry, Patrick Henry, Richard Henry Lee, and George Mason spoke out against ratification.

Critics objected that a bill of rights had not been included, that the President had too much independence, and that the Senate was too aristocratic. They also thought Congress had too many powers and the national government had too much authority. Friends of the Constitution rallied support for ratification. They became known as *Federalists.* Their opponents were called *Anti-Federalists.* The two groups promoted their causes in newspapers, in pamphlets, and in debates in the ratifying conventions (see **Anti-Federalists; Federalist, The; Federalist Party**). The groups developed into the first American political parties.

Virginia ratified the Constitution on June 25, 1788, and New York did so on July 26. Early in January 1789, all the ratifying states except New York selected presidential electors in their legislatures or by a direct vote of the people. On February 4, the electors named George Washington as the first President of the United States. The first Congress under the Constitution met in New York City on March 4. Washington was inaugurated on April 30. North Carolina and Rhode Island refused to approve the Constitution and take part in the new government until Congress agreed to add a bill of rights.

The Bill of Rights

The Federalists might never have obtained ratification in several important states if they had not promised to support amendments to the Constitution. These amendments were written to protect individual liberties against possible unjust rule by the national government.

Interesting facts about the Constitution

Which two signers of the Constitution later became U.S. Presidents? George Washington and James Madison.

Which signers of the Declaration of Independence also signed the Constitution? George Clymer, Benjamin Franklin, Robert Morris, George Read, Roger Sherman, and James Wilson.

Who were the youngest and oldest signers of the Constitution? Youngest: Jonathan Dayton, 26 years old. Oldest: Benjamin Franklin, 81 years old.

Who was the first delegate to sign the Constitution? George Washington.

Who was called the "Father of the Constitution"? James Madison earned this title because he was a leading member of the convention and wrote a record of the delegates' debates.

Who actually "wrote" the Constitution? Gouverneur Morris.

When was the Constitution signed? Sept. 17, 1787.

What state did not send representatives to the Constitutional Convention? Rhode Island refused to send representatives because it did not want the federal government to interfere with Rhode Island's affairs.

In what order did the delegates sign the Constitution? In geographical order from north to south: New Hampshire, Massachusetts, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia, North Carolina, South Carolina, and Georgia.

Which three leading delegates refused to sign the Constitution? Elbridge Gerry, George Mason, and Edmund Randolph refused because they objected to the powers that the Constitution gave the federal government.

How many delegates signed the Constitution? 39.

Where is the original Constitution displayed? In the National Archives Building in Washington, D.C.

Most state constitutions that were adopted during the Revolution had included a clear declaration of the rights of all people. Most Americans believed that no constitution could be considered complete without such a declaration. George Mason of Virginia was responsible for the first and most famous American bill of rights, the Virginia Declaration of Rights of 1776. He and Patrick Henry might have prevented ratification of the Constitution in Virginia if the Federalists had not agreed to their demands for amendments.

James Madison led the new Congress in proposing amendments. He suggested 15 amendments, and the Congress accepted 12 of them to be submitted for approval by the states under the amending process outlined in the Fifth Article of the Constitution. By Dec. 15, 1791, enough states had approved 10 of the 12 amendments to make them a permanent addition to the Constitution. These amendments are known as the *Bill of Rights.*

One of the two unapproved amendments dealt with the size of the House of Representatives. It would have changed representation from no more than one representative for every 30,000 people to one for every 50,000 people. The other unapproved amendment provided that whenever Congress changed the salaries of its members, the change could not take effect until after the next election of representatives had been held. This amendment was ratified in 1992. See **Bill of rights.**

The development of the Constitution

Through the years, the Constitution has developed to meet changing needs. James Madison declared, "In

framing a system which we wish to last for ages, we should not lose sight of the changes which ages will produce." The Constitution was designed to serve the interests of the people—rich and poor, Northerners and Southerners, farmers, workers, and business people.

The Anti-Federalists accepted defeat when the Constitution was adopted and set about to win power under its rules. Their action set a style for American politics that has never changed. Americans sometimes feel dissatisfied with the policies of those who govern. But few Americans have condemned the constitutional system or demanded a second constitutional convention.

Delegates to the Constitutional Convention believed strongly in the rule of the majority, but they wanted to protect minorities against any unjustness by the majority. They achieved this goal by separating and balancing the powers of government. Other basic constitutional aims included respect for the rights of individuals and states, rule by the people, separation of church and state, and supremacy of the national government.

Amendments are additions to the Constitution. Today, there are 27 amendments.

An amendment may be proposed by two-thirds of each house of Congress, or by a national convention called by Congress in response to requests by two-thirds of the state legislatures. It becomes part of the Constitution after being ratified either by the legislatures of three-fourths of the states or by conventions in three-fourths of the states. Congress decides which form of ratification should be used and how much time

Index to the Constitution

This index lists some important subjects discussed in the Constitution and the specific article or amendment that deals with each one. The index also gives the page in this article on which the information appears.

the states have to consider each amendment. In many cases, Congress has chosen a seven-year period for such consideration. The process of amending the Constitution was designed to be difficult, so that the nation would have to think carefully about any proposed changes before adopting them.

Laws have added to the meaning of the Constitution. The delegates to the Constitutional Convention knew they could not write laws for every possible situation. Therefore, they gave Congress the right to pass all laws that were "necessary and proper" to carry out powers granted by the Constitution to the president, Congress, and federal courts. Congress has passed laws to establish such administrative organizations as the Federal Aviation Administration and the Postal Service. Congress has also passed laws to regulate interstate commerce, thereby controlling many aspects of the economy.

Court decisions. Federal and state judges apply the Constitution in many court cases. The Supreme Court has the final authority in interpreting the meaning of the Constitution in any specific case. The court has the power of *judicial review*—that is, it can declare a law unconstitutional. The court has this power largely because of the decision of Chief Justice John Marshall in the case of *Marbury v. Madison* in 1803 (see **Marbury v. Madison**). Since that time, the court has ruled that all or parts of more than 125 federal laws and over 1,000 state laws were unconstitutional. The court can also overrule itself, and it has done so about 200 times.

Presidential actions. Strong presidents have used their authority to expand the simple words of the Second Article of the Constitution into a source of great presidential power. Such presidents include George Washington, Thomas Jefferson, Andrew Jackson, Abraham Lincoln, Theodore Roosevelt, Woodrow Wilson, and Franklin D. Roosevelt. Washington, for example, made the president the leading figure in foreign affairs. Lincoln used the powers set forth in the article to free slaves during the American Civil War (1861-1865).

Customs have made the Constitution flexible and have added to the powers of the national government. For example, the president's Cabinet developed from the words in the Second Article that permit the chief executive to "require the opinion, in writing, of the principal officer in each of the executive departments, upon any subject relating to the duties of their respective offices. . . ."

State and party actions. The Constitution provides for a general method of electing a president. It does not mention political parties. But state laws and political-party practices have changed the constitutional system of voting into the exciting campaigns and elections that take place today.

The Constitution has continued to develop in response to the demands of an ever-growing society through all these methods. Yet the spirit and wording of the Constitution have remained constant. People of each generation have applied its provisions to their own problems in ways that seem reasonable to them.

The British statesman William E. Gladstone described the Constitution as "the most wonderful work ever struck off at a given time by the brain and purpose of man." In a world of change and struggle, the American people have no more precious possession than this great document. The complete text of the Constitution of the United States, with explanatory notes, begins on the next page. Bruce Allen Murphy

Related articles in *World Book* include:

Biographies

There is a biography in *World Book* on each delegate who signed the Constitution of the United States as listed after the Seventh Article. See also the biographies on the following notable Americans:

Adams, John
Adams, Samuel
Gerry, Elbridge
Henry, Patrick
Jay, John
Jefferson, Thomas
Marshall, John
Mason, George
Randolph, Edmund

History

Albany Congress
Annapolis Convention
Anti-Federalists
Articles of Confederation
Continental Congress
Federalist, The
Federalist Party
Founding Fathers
Shays's Rebellion
United States, History of the (Forming a new nation)

Other related articles

Bill of rights
Congress of the United States
Court
Fifteenth Amendment
Fifth Amendment
Fourteenth Amendment
Government
Political party
President of the United States
Second Amendment
States' rights
Supreme Court of the United States
United States, Government of the
Vice President of the United States
Voting

Outline

I. The supreme law of the land
II. The need for the Constitution
III. The Constitutional Convention
A. The background of the Constitution
B. The compromises
IV. Ratifying the Constitution
V. The Bill of Rights
VI. The development of the Constitution

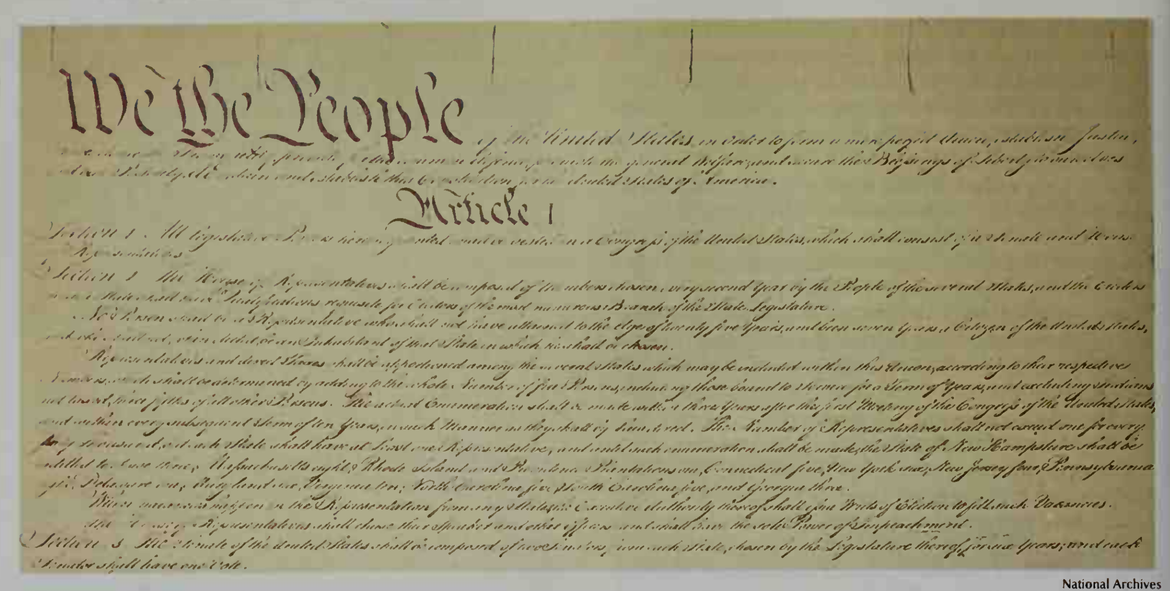
Questions

Why were the Articles of Confederation of 1781 inadequate for governing the United States?
What compromises were made in forming the Constitution?
What were some major objections against the newly formed Constitution?
How did controversy over the Constitution result in creating the first American political parties?
In what two states was there especially powerful organized opposition to ratifying the Constitution?
What government body has the final authority in interpreting the Constitution?
What were some of the reasons for including a bill of rights in the Constitution?
What are *delegated powers? Implied powers? Reserved powers? Concurrent powers?*

Additional resources

Amar, Akhil R., and Hirsch, Alan. *For the People: What the Constitution Really Says About Your Rights.* Free Pr., 1998.
Collier, Christopher and James L. *Creating the Constitution, 1787.* Benchmark Bks., 1998. Younger readers.
Levy, Leonard W., and Karst, K. L., eds. *Encyclopedia of the American Constitution.* 2nd ed. 6 vols. Macmillan, 2000.
Newman, Roger K., ed. *The Constitution and Its Amendments.* 4 vols. Macmillan, 1999.

(Text of the U.S. Constitution begins on the next page)



National Archives

This copy of the Constitution shows the Preamble and part of the first article.

The Constitution of the United States

The text of the Constitution is printed here in boldface type. All words are given their modern spelling and capitalization. Brackets [ ] indicate parts that have been changed or set aside by amendments. The paragraphs printed in lightface type are not part of the Constitution. They explain the meaning of certain passages or describe how certain passages have worked in practice.

Preamble

We the people of the United States, in order to form a more perfect Union, establish justice, insure domestic tranquility, provide for the common defense, promote the general welfare, and secure the blessings of liberty to ourselves and our posterity, do ordain and establish this Constitution for the United States of America.

Article I

The legislative branch

Section 1. **All legislative powers herein granted shall be vested in a Congress of the United States, which shall consist of a Senate and House of Representatives.**

The first three articles of the Constitution divide the powers of the United States government among three separate branches: (1) the legislative branch, represented by Congress; (2) the executive branch, represented by the President; and (3) the judicial branch, represented by the Supreme Court. This division, called the *separation of powers,* is designed to prevent any branch of the government from becoming too powerful.

Article I says that only Congress has the power to make laws. Congress cannot give these powers to any other body. Through the years, however, Congress has created various federal agencies to make regulations and put its policies into practice. Such agencies include the Federal Trade Commission, the Federal Power Commission, and the Commission on Civil Rights.

The two-house Congress was one of the most important compromises of the Constitutional Convention. The small states at the convention supported the *New Jersey plan,* under which each state would have had the same number of representatives. The large states at the convention wanted the *Virginia plan,* which provided representation based on population. As a compromise, one house was chosen according to each plan.

The House of Representatives

Section 2. **(1) The House of Representatives shall be composed of members chosen every second year by the people of the several states, and the electors in each state shall have the qualifications requisite for electors of the most numerous branch of the state legislature.**

Members of the House of Representatives are elected to two-year terms. If a person is eligible to vote for the "most numerous branch" of his or her state legislature, he or she is also eligible to vote for members of Congress. The "most numerous branch" is the house that has the most members. All states except Nebraska have a two-house state legislature. The question of who can vote for state legislators is entirely up to the state, subject to the restrictions of the Constitution and federal law. The 15th, 19th, 24th, and 26th amendments forbid the states to deny or restrict a citizen's right to vote because of race, sex, or failure to pay a tax; or age if the person is at least 18 years old.

(2) No person shall be a representative who shall not have attained to the age of twenty-five years, and been seven years a citizen of the United States, and who shall not, when elected, be an inhabitant of that state in which he shall be chosen.

Each state decides for itself the requirements for legal residence, subject to constitutional limits. Most representatives live not only in the state but also in the district from which they are chosen.

(3) Representatives and direct taxes shall be apportioned among the several states which may be included within this Union, according to their respective numbers, [which shall be determined by adding to the whole number of free persons, including those bound to service for a term of years, and excluding Indians not taxed, three-fifths of all other persons].

The actual enumeration shall be made within three years after the first meeting of the Congress of the United States, and within every subsequent term of ten years, in such manner as they shall by law direct. The number of representatives shall not exceed one for every thirty thousand, but each state shall have at least one representative; [and until such enumeration shall be made, the state of New Hampshire shall be entitled to choose 3, Massachusetts 8, Rhode Island and Providence Plantations 1, Connecticut 5, New York 6, New Jersey 4, Pennsylvania 8, Delaware 1, Maryland 6, Virginia 10, North Carolina 5, South Carolina 5, and Georgia 3].

The effect of this paragraph has been greatly changed, both by amendments and by new conditions. It now provides only three things: (1) the number of representatives given to each state shall be based on its population; (2) Congress must see that the people of the United States are counted every 10 years; and (3) each state gets at least one representative.

The Founding Fathers probably considered the words "and direct taxes" to apply to poll and property taxes. The 16th Amendment gives Congress the right to tax a person according to the size of his or her income, rather than to tax a person according to the population of the state in which the person happens to live.

In the reference to "three-fifths of all other persons," the "other persons" meant black slaves. Since there are no longer any slaves in the United States, this part of the paragraph no longer has any meaning.

The average House district has well over half a million people, so the requirement that there shall be no more than one representative for every 30,000 people no longer has any practical force. In 1929, Congress fixed the total number of representatives at 435.

(4) When vacancies happen in the representation from any state, the executive authority thereof shall issue writs of election to fill such vacancies.

If a vacancy occurs in a House seat, the state governor must call a special election to fill it. However, if the next regularly scheduled election is to be held soon, the governor may allow the seat to remain empty rather than call a special election.

(5) The House of Representatives shall choose their Speaker and other officers; and shall have the sole power of impeachment.

The House chooses an officer called the Speaker to lead meetings (see **Speaker**). The House alone has the power to bring impeachment charges against an official. The Senate tries impeachment cases. See **Impeachment**.

The Senate

Section 3. (1) The Senate of the United States shall be composed of two senators from each state, [chosen by the legislature thereof,] for six years; and each senator shall have one vote.

The Constitution at first provided that each state legislature should pick two senators. The 17th Amendment changed this rule by allowing the voters of each state to choose their own senators.

(2) Immediately after they shall be assembled in consequence of the first election, they shall be divided as equally as may be into three classes. The seats of the senators of the first class shall be vacated at the expiration of the second year, of the second class at the expiration of the fourth year, and of the third class at the expiration of the sixth year, so that one-third may be chosen every second year; [and if vacancies happen by resignation, or otherwise, during the recess of the legislature of any state, the executive thereof may make temporary appointments until the next meeting of the legislature, which shall then fill such vacancies].

Senators are elected to six-year terms. Every two years, one-third of the senators are elected and two-thirds are holdovers. This arrangement makes the Senate a continuing body, unlike the House, whose entire membership is elected every two years. The 17th Amendment changed the method of filling vacancies in the Senate. The governor chooses a senator until the people elect one.

(3) No person shall be a senator who shall not have attained to the age of thirty years, and been nine years a citizen of the United States, and who shall not, when elected, be an inhabitant of that state for which he shall be chosen.

In 1806, Henry Clay of Kentucky was appointed to fill an unexpired term in the Senate. He was only 29, a few months younger than the minimum age, but no one challenged the appointment. In 1793, Albert Gallatin was elected to the Senate from Pennsylvania. He was removed from office when the Senate ruled that he had not yet been a citizen for nine years.

(4) The Vice President of the United States shall be president of the Senate, but shall have no vote, unless they be equally divided.

The Vice President serves as president of the Senate, but votes only when a tie vote occurs. The Vice President's power to break ties can be important. In 1789, for example, Vice President John Adams cast the vote that decided the President could remove Cabinet members without Senate approval.

(5) The Senate shall choose their other officers, and also a president pro tempore, in the absence of the Vice President, or when he shall exercise the office of President of the United States.

The Senate elects an officer called the president pro tempore to lead meetings when the Vice President is absent.

(6) The Senate shall have the sole power to try all impeachments. When sitting for that purpose, they shall be on oath or affirmation. When the President of the United States is tried, the Chief Justice shall preside: and no person shall be convicted without the concurrence of two-thirds of the members present.

The provision that the Chief Justice, rather than the Vice President, shall preside over the Senate when a President is on trial probably grows out of the fact that a conviction would make the Vice President the President. The phrase "on oath or affirmation" means that senators are placed under oath when trying impeachment cases, just as jurors are in a regular court trial.

(7) Judgment in cases of impeachment shall not extend further than to removal from office, and disqualification to hold and enjoy any office of honor, trust or profit under the United States: but the party convicted shall nevertheless be liable and subject to indictment, trial, judgment and punishment, according to law.

If an impeached person is found guilty, he or she can be removed from office and forbidden to hold federal office again. The Senate cannot impose any other punishment, but the person may also be tried in regular courts. The Senate has convicted only seven people, all of them judges. These men were removed from office.

Organization of Congress

Section 4. (1) The times, places and manner of holding elections for senators and representatives, shall be prescribed in each state by the legislature thereof; but the Congress may at any time by law make or alter such regulations, [except as to the places of choosing senators].

As long as state legislatures chose the senators, it would not do to let Congress fix the place of choosing. This would have amounted to giving Congress the power to tell each state where to locate its capital. The words of the Constitution "except as to the places of choosing senators" were set aside by the 17th Amendment.

(2) The Congress shall assemble at least once in every year, [and such meeting shall be on the first Monday in December,] unless they shall by law appoint a different day.

In Europe, monarchs could keep parliaments from meeting, sometimes for many years, simply by not calling them together. This is the reason for the requirement that the Congress of the United States must meet at least once a year. The 20th Amendment changed the date of the opening day of the session to January 3, unless Congress sets another date by law.

Section 5. (1) Each house shall be the judge of the elections, returns and qualifications of its own members, and a majority of each shall constitute a quorum to do business; but a smaller number may adjourn from day to day, and may be authorized to compel the attendance of absent members, in such manner, and under such penalties as each house may provide.

Each house determines if its members are legally qualified and have been elected fairly. In judging the qualifications of its members, each house may consider only the age, citizenship, and residence requirements set forth in the Constitution. In acting on motions to expel a member, however, either house of Congress may consider other matters bearing on that member's fitness for office. A *quorum* is a group large enough to carry on business. Discussion and debate can go on whether a quorum is present or not, as long as a quorum comes in to vote.

(2) Each house may determine the rules of its proceedings, punish its members for disorderly behavior, and, with the concurrence of two-thirds, expel a member.

Either house can expel one of its members by a two-thirds vote. Each house makes its own rules. For example, the House of Representatives puts strict time limits on debate to speed up business. It is much more difficult to end debate in the Senate. A senator may speak as long as he or she wishes. Senators use this privilege to make long speeches called *filibusters* to delay Senate action. The Senate, however, may vote for *cloture,* a motion to end debate. On most matters, cloture requires a vote of 60 senators, or three-fifths of the total Senate membership. See Cloture.

(3) Each house shall keep a journal of its proceedings, and from time to time publish the same, excepting such parts as may in their judgment require secrecy; and the yeas and nays of the members of either house on any question shall, at the desire of one-fifth of those present, be entered on the journal.

The House *Journal* and the Senate *Journal* are published at the end of each session of Congress. They list all the bills and resolutions considered during the session, as well as every vote. All messages from the President to Congress also are included. The journals are considered the official documents for the proceedings of Congress.

(4) Neither house, during the session of Congress, shall, without the consent of the other, adjourn for more than three days, nor to any other place than that in which the two houses shall be sitting.

Section 6. (1) The senators and representatives shall receive a compensation for their services, to be ascertained by law, and paid out of the treasury of the United States. They shall in all cases, except treason, felony and breach of the peace, be privileged from arrest during their attendance at the session of their respective houses, and in going to and returning from the same; and for any speech or debate in either house, they shall not be questioned in any other place.

The privilege of *immunity* (freedom from arrest) while going to and from congressional business has little importance today. Members of Congress, like anyone else, may be arrested, tried, convicted, and sent to prison.

Congressional immunity from charges of *libel* and *slander* remains important. Libel is an untrue written statement that damages a person's reputation. Slander is a spoken statement that does so. Immunity under the speech and debate clause means that members of Congress may say whatever they wish in connection with congressional business without fear of being sued. This immunity extends to anything said by members during debate, in an official report, or while voting.

(2) No senator or representative shall, during the time for which he was elected, be appointed to any civil office under the authority of the United States, which shall have been created, or the emoluments whereof shall have been increased during such time; and no person holding any office under the United States, shall be a member of either house during his continuance in office.

These provisions keep members of Congress from creating jobs to which they can later be appointed, from raising salaries of jobs they hope to hold in the future, or from holding office in the other branches of government while they are serving in Congress.

Section 7. (1) All bills for raising revenue shall originate in the House of Representatives; but the Senate may propose or concur with amendments as on other bills.

Tax bills must originate in the House. The tradition that tax laws should originate in the lower house of the legislature came from England. There, the lower house—the House of Commons—is more likely to reflect the people's wishes because the people elect its members. They do not elect the upper house, the House of Lords. In the United States, this rule has little importance because the people elect both the Senate and the House. In addition, the Senate can amend a tax bill to such an extent that it rewrites the whole measure.

(2) Every bill which shall have passed the House of Representatives and the Senate, shall, before it become a law, be presented to the President of the United States; if he approve he shall sign it, but if not he shall return it, with his objections to that house in which it shall have originated, who shall enter the objections at large on their journal, and proceed to reconsider it. If after such reconsideration two-thirds of that house shall agree to pass the bill, it shall be sent, together with the objections, to the other house, by which it shall likewise be reconsidered, and if approved by two-thirds of that house, it shall become a law. But in all such cases the votes of both houses shall be determined by yeas and nays, and the names of the persons voting for and against the bill shall be entered on the journal of each house respectively. If any bill shall not be returned by the President within ten days (Sundays excepted) after it shall have been presented to him, the same shall be a law, in like manner as if he had signed it, unless the Congress by their adjournment prevent its return, in which case it shall not be a law.

A bill passed by Congress goes to the President for the President's signature. If the President disapproves the bill, it must be returned to Congress with a statement of the objections within 10 days, not including Sundays. This action is called a *veto.* Congress can pass a law over the President's veto by a two-thirds vote of each house of those members present. The President can also let a bill become law without signing it merely by letting 10 days pass. But a bill sent to the President during the last 10 days of a session of Congress cannot become law unless it is signed. If a bill the President dislikes reaches the President near the end of a session, the bill may simply be held unsigned. This practice is known as a *pocket veto.*

In 1996, Congress enacted a law designed to add to the veto powers established by the Constitution. This law, which went into effect in 1997, gave the President the power to veto certain parts of bills passed by Congress. These parts included some spending items and tax breaks. The power to veto individual items in bills is often called a *line-item veto.* In 1998, however, the Supreme Court ruled that the power created by the 1996 law was unconstitutional. See Veto.

(3) Every order, resolution, or vote to which the concurrence of the Senate and House of Representatives may be necessary (except on a question of adjournment) shall be presented to the President of the United States; and before the same shall take effect, shall be approved by him, or being disapproved by him, shall be repassed by two-thirds of the Senate and House of Representatives, according to the rules and limitations prescribed in the case of a bill.

Powers granted to Congress

Section 8. **The Congress shall have power:**

(1) To lay and collect taxes, duties, imposts and excises, to pay the debts and provide for the common defense and general welfare of the United States; but all duties, imposts and excises shall be uniform throughout the United States;

Duties are taxes on goods coming into the United States. *Excises* are taxes on sales, use, or production, and sometimes on business procedures or privileges. For example, corporation taxes, cigarette taxes, and amusement taxes are excises. *Imposts* is a general tax term that includes both duties and excises.

(2) To borrow money on the credit of the United States;

(3) To regulate commerce with foreign nations, and among the several states, and with the Indian tribes;

This section, called the *commerce clause,* gives Congress some of its most important powers. The Supreme Court has interpreted *commerce* to mean not only trade but also all kinds of commercial activity. Commerce "among the several states" is usually called *interstate commerce.* The Supreme Court has ruled that interstate commerce includes not only transactions across state boundaries but also any activity that affects commerce in more than one state. The court has interpreted the word *regulate* to mean *encourage, promote, protect, prohibit,* or *restrain.* As a result, Congress can pass laws and provide funds to improve waterways, to enforce air safety measures, and to forbid interstate shipment of certain goods. It can regulate the movement of people, of trains, of stocks and bonds, and even of television signals. Congress has made it a federal crime to flee across state lines from state or local police. It also has forbidden people who operate interstate facilities or who serve interstate passengers to treat customers unfairly because of race. See **Interstate commerce.**

(4) To establish an uniform rule of naturalization, and uniform laws on the subject of bankruptcies throughout the United States;

(5) To coin money, regulate the value thereof, and of foreign coin, and fix the standard of weights and measures;

From this section, along with the section that allows the Congress to regulate commerce and to borrow money, Congress gets its right to charter national banks and to establish the Federal Reserve System. See **Federal Reserve System.**

(6) To provide for the punishment of counterfeiting the securities and current coin of the United States;

Securities are government bonds.

(7) To establish post offices and post roads;

(8) To promote the progress of science and useful arts, by securing for limited times to authors and inventors the exclusive right to their respective writings and discoveries;

Photographs and films may also be copyrighted under this rule (see **Copyright; Patent**).

(9) To constitute tribunals inferior to the Supreme Court;

Examples of federal courts "inferior to the Supreme Court" include the U.S. district courts and the U.S. courts of appeals.

(10) To define and punish piracies and felonies committed on the high seas, and offenses against the law of nations;

Congress, rather than the states, has jurisdiction over crimes committed at sea.

(11) To declare war, grant letters of marque and reprisal, and make rules concerning captures on land and water;

Only Congress can declare war. However, the President, as commander in chief, has engaged the United States in wars without a declaration by Congress. Undeclared wars include the Korean War (1950-1953), the Vietnam War (1957-1975), and the Persian Gulf War (1991). *Letters of marque and reprisal* are documents that authorize private vessels to attack enemy shipping.

(12) To raise and support armies, but no appropriation of money to that use shall be for a longer term than two years;

(13) To provide and maintain a navy;

(14) To make rules for the government and regulation of the land and naval forces;

(15) To provide for calling forth the militia to execute the laws of the Union, suppress insurrections and repel invasions;

Congress has given the President power to decide when a state of invasion or *insurrection* (uprising) exists. At such times, the President can call out the National Guard.

(16) To provide for organizing, arming, and disciplining, the militia, and for governing such part of them as may be employed in the service of the United States, reserving to the states respectively, the appointment of the officers, and the authority of training the militia according to the discipline prescribed by Congress;

The federal government helps the states maintain the militia, also known as the National Guard. Until 1916, the states controlled the militia entirely. That year, the National Defense Act provided for federal funding of the guard and for drafting the guard into national service under certain circumstances.

(17) To exercise exclusive legislation in all cases whatsoever, over such district (not exceeding ten miles square) as may, by cession of particular states, and the acceptance of Congress, become the seat of the government of the United States, and to exercise like authority over all places purchased by the consent of the legislature of the state in which the same shall be for the erection of forts, magazines, arsenals, dockyards, and other needful buildings;—And

This section makes Congress the legislative body not only for the District of Columbia, but also for federal property on which forts and other federal works or buildings are located.

(18) To make all laws which shall be necessary and proper for carrying into execution the foregoing powers, and all other powers vested by this Constitution in the government of the United States, or in any department or officer thereof.

This section is known as the "necessary and proper" clause or the *elastic clause.* It allows Congress to deal with many matters that are not specifically mentioned in the Constitution but are suggested by powers granted to Congress in Article I. As times have changed, Congress has been able to pass needed laws with few amendments to the Constitution. This flexibility helps explain why the Constitution is one of the oldest written constitutions.

Powers forbidden to Congress

Section 9. **(1) The migration or importation of such persons as any of the states now existing shall think proper to admit, shall not be prohibited by the Congress prior to the year one thousand eight hundred and eight, but a tax or duty may be imposed on such importation, not exceeding ten dollars for each person.**

This paragraph refers to the slave trade. Dealers in slaves, as well as some slaveholders, wanted to make sure that Congress could not stop anyone from bringing African slaves into the country before the year 1808. That year, Congress did ban the importing of slaves into the United States.

(2) The privilege of the writ of *habeas corpus* shall not be suspended, unless when in cases of rebellion or invasion the public safety may require it.

A *writ of habeas corpus* is a legal order that commands people who have a person in custody to bring the person into court.

They must explain in court why the person is being restrained. If their explanation is unsatisfactory, the judge can order the prisoner released. See Habeas corpus.

(3) No bill of attainder or *ex post facto* law shall be passed.

A *bill of attainder* is an act passed by a legislature to punish a person without trial. An *ex post facto law* is one that provides punishment for an act that was not illegal when the act was committed. See Attainder; Ex post facto.

(4) No capitation, [or other direct,] tax shall be laid, unless in proportion to the census or enumeration herein before directed to be taken.

A *capitation* is a tax that is collected equally from everyone. A capitation is also called a *head tax* or a *poll tax*. The Supreme Court held that this section of the Constitution prohibits an income tax. The 16th Amendment set aside the court's decision.

(5) No tax or duty shall be laid on articles exported from any state.

In this sentence, *exported* means sent to other states or to foreign countries. The Southern States feared that the new government would tax their exports and that their economies would suffer as a result. This sentence forbids such a tax. However, Congress can prohibit shipment of certain items or regulate the conditions of their shipment.

(6) No preference shall be given by any regulation of commerce or revenue to the ports of one state over those of another: nor shall vessels bound to, or from, one state, be obliged to enter, clear, or pay duties in another.

Congress cannot make laws concerning trade that favor one state over another. Ships going from one state to another need not pay taxes to do so.

(7) No money shall be drawn from the treasury, but in consequence of appropriations made by law; and a regular statement and account of the receipts and expenditures of all public money shall be published from time to time.

Government money cannot be spent without the consent of Congress. Congress must issue a financial statement from time to time. Congress authorizes money for most government programs in lump sums because too much time would be needed to authorize each item separately.

(8) No title of nobility shall be granted by the United States: And no person holding any office of profit or trust under them, shall, without the consent of the Congress, accept of any present, emolument, office, or title, of any kind whatsoever, from any king, prince, or foreign state.

Congress cannot give anyone a title of nobility, such as countess or duke. Federal officials may not accept a gift, office, payment, or title from a foreign country without the consent of Congress.

Powers forbidden to the states

Section 10. **(1) No state shall enter into any treaty, alliance, or confederation; grant letters of marque and reprisal; coin money; emit bills of credit; make anything but gold and silver coin a tender in payment of debts; pass any bill of attainder, *ex post facto* law, or law impairing the obligation of contracts, or grant any title of nobility.**

(2) No state shall, without the consent of the Congress, lay any imposts or duties on imports or exports, except what may be absolutely necessary for executing its inspection laws: and the net produce of all duties and imposts, laid by any state on imports or exports, shall be for the use of the treasury of the United States, and all such laws shall be subject to the revision and control of the Congress.

Without the consent of Congress, a state cannot tax goods entering or leaving the state except for small fees to cover the cost of inspection. Profits from a tax on interstate commerce go to the federal government.

(3) No state shall, without the consent of Congress, lay any duty of tonnage, keep troops, or ships of war in time of peace, enter into any agreement or compact with another state, or with a foreign power, or engage in war, unless actually invaded, or in such imminent danger as will not admit of delay.

Only the federal government has the power to make treaties and to carry out measures for national defense.

Article II

The executive branch

Section 1. **(1) The executive power shall be vested in a President of the United States of America. He shall hold his office during the term of four years, and, together with the Vice President, chosen for the same term, be elected, as follows:**

(2) Each state shall appoint, in such manner as the legislature thereof may direct, a number of electors, equal to the whole number of senators and representatives to which the state may be entitled in the Congress: but no senator or representative, or person holding an office of trust or profit under the United States, shall be appointed an elector.

This section establishes the Electoral College, a group of people chosen by the voters of each state to elect the President and Vice President (see Electoral College).

(3) [The electors shall meet in their respective states, and vote by ballot for two persons, of whom one at least shall not be an inhabitant of the same state with themselves. And they shall make a list of all the persons voted for, and of the number of votes for each; which list they shall sign and certify, and transmit sealed to the seat of the government of the United States, directed to the president of the Senate. The president of the Senate shall, in the presence of the Senate and House of Representatives, open all the certificates, and the votes shall then be counted. The person having the greatest number of votes shall be the President, if such number be a majority of the whole number of electors appointed; and if there be more than one who have such majority, and have an equal number of votes, then the House of Representatives shall immediately choose by ballot one of them for President; and if no person have a majority, then from the five highest on the list the said House shall in like manner choose the President. But in choosing the President, the votes shall be taken by states, the representation from each state having one vote; a quorum for this purpose shall consist of a member or members from two-thirds of the states, and a majority of all the states shall be necessary to a choice. In every case, after the choice of the President, the person having the greatest number of votes of the electors shall be the Vice President. But if there should remain two or more who have equal votes, the Senate shall choose from them by ballot the Vice President.]

The 12th Amendment changed this procedure for electing the President and Vice President.

(4) The Congress may determine the time of choosing the electors, and the day on which they shall give their votes; which day shall be the same throughout the United States.

(5) No person except a natural-born citizen, or a citizen of the United States at the time of the adoption of this Constitution, shall be eligible to the office of President; neither shall any person be eligible to that office who shall not have attained to the age of thirty-five years, and been fourteen years a resident within the United States.

(6) In case of the removal of the President from office, or of his death, resignation, or inability to discharge the powers and duties of the said office, the same shall devolve on the Vice President, and the Congress may by law provide for the case of removal, death, resignation or inability, both of the President and Vice President, declaring what officer shall then act as President, and such officer shall act accordingly, until the disability be removed, or a President shall be elected.

On Aug. 9, 1974, President Richard M. Nixon resigned as chief executive and was succeeded by Vice President Gerald R. Ford. Until then, only death had ever cut short the term of a President of the United States. The 25th Amendment provides that the Vice President succeed to the presidency if the President becomes disabled, and specifies the conditions applying to that succession. See **Presidential succession.**

(7) The President shall, at stated times, receive for his services, a compensation, which shall neither be increased nor diminished during the period for which he shall have been elected, and he shall not receive within that period any other emolument from the United States, or any of them.

The Constitution made it possible for a poor person to become President by providing a salary for that office. The President's salary cannot be raised or lowered during his or her term of office. The chief executive may not receive any other pay from the federal government or the states.

(8) Before he enter on the execution of his office, he shall take the following oath or affirmation:—"I do solemnly swear (or affirm) that I will faithfully execute the office of President of the United States, and will to the best of my ability, preserve, protect and defend the Constitution of the United States."

The Constitution does not say who shall administer the oath to the newly elected President. President George Washington was sworn in by Robert R. Livingston, then a state official in New York. After that, it became customary for the chief justice of the United States to administer the oath. Calvin Coolidge was sworn in by his father, a justice of the peace, at his home in Vermont. Coolidge took the oath again before Justice Adolph A. Hoehling of the Supreme Court of the District of Columbia.

Section 2. **(1) The President shall be commander in chief of the Army and Navy of the United States, and of the militia of the several states, when called into the actual service of the United States; he may require the opinion, in writing, of the principal officer in each of the executive departments, upon any subject relating to the duties of their respective offices, and he shall have power to grant reprieves and pardons for offenses against the United States, except in cases of impeachment.**

The President's powers as commander in chief are far-reaching. But even in wartime, the President must obey the law.

(2) He shall have power, by and with the advice and consent of the Senate, to make treaties, provided two-thirds of the senators present concur; and he shall nominate, and by and with the advice and consent of the Senate, shall appoint ambassadors, other public ministers and consuls, judges of the Supreme Court, and all other officers of the United States, whose appointments are not herein otherwise provided for, and which shall be established by law: but the Congress may by law vest the appointment of such inferior officers, as they think proper, in the President alone, in the courts of law, or in the heads of departments.

The framers of the Constitution intended that in some matters the Senate should serve as an advisory body for the President.

The President can make treaties and appoint various government officials. But two-thirds of the senators present must approve before a treaty is confirmed. Also, high appointments require approval of more than half the senators present.

(3) The President shall have power to fill up all vacancies that may happen during the recess of the Senate, by granting commissions which shall expire at the end of their next session.

This means that when the Senate is not in session, the President can make temporary appointments to offices which require Senate confirmation.

Section 3. **He shall from time to time give to the Congress information of the state of the Union, and recommend to their consideration such measures as he shall judge necessary and expedient; he may, on extraordinary occasions, convene both houses, or either of them, and in case of disagreement between them, with respect to the time of adjournment, he may adjourn them to such time as he shall think proper; he shall receive ambassadors and other public ministers; he shall take care that the laws be faithfully executed, and shall commission all the officers of the United States.**

The President gives a State of the Union message to Congress each year. Presidents George Washington and John Adams delivered their messages in person. For more than 100 years after that, most Presidents sent a written message, which was read in Congress. President Woodrow Wilson delivered his State of the Union messages in person, as did President Franklin D. Roosevelt and all Presidents after Roosevelt. The President's messages often have great influence on public opinion, and thus on Congress. Famous messages to Congress include the Monroe Doctrine and President Wilson's "Fourteen Points."

During the 1800's, Presidents often called Congress into session. Today, Congress is in session most of the time. No President has ever had to adjourn a session of Congress.

The responsibility to "take care that the laws be faithfully executed" puts the President at the head of law enforcement for the national government. Every federal official, civilian or military, gets his or her authority from the President.

Section 4. **The President, Vice President and all civil officers of the United States, shall be removed from office on impeachment for, and conviction of, treason, bribery, or other high crimes and misdemeanors.**

Article III

The judicial branch

Section 1. **The judicial power of the United States, shall be vested in one Supreme Court, and in such inferior courts as the Congress may from time to time ordain and establish. The judges, both of the Supreme and inferior courts, shall hold their offices during good behavior, and shall, at stated times, receive for their services, a compensation, which shall not be diminished during their continuance in office.**

The Constitution makes every effort to keep the courts independent of both the legislature and the President. The guarantee that judges shall hold office during "good behavior" means that, unless they are impeached and convicted, they can hold office for life. This protects judges from any threat of dismissal by the President. The rule that a judge's salary may not be reduced protects the judge against pressure from Congress, which could otherwise threaten to fix the salary so low that the judge could be forced to resign. See **Court; Supreme Court of the United States.**

Section 2. **(1) The judicial power shall extend to all cases, in law and equity, arising under this Constitution, the laws of the United States, and treaties made, or which shall be made, under their authority;—to all cases affecting ambassadors, other public ministers and consuls;—to all cases of admiralty and maritime jurisdiction;—to controversies to which the United States shall be a party;—to controversies between two or more states; [between a state and citizens of another state;] between citizens of different states;—between citizens of the same state claiming lands under grants of different states, and between a state, or the citizens thereof, and foreign states, [citizens or subjects].**

The right of the federal courts to handle "cases arising under this Constitution" is the basis of the Supreme Court's right to declare laws of Congress unconstitutional. This right of "judicial review" was established by Chief Justice John Marshall's historic decision in the case of *Marbury v. Madison* (1803). See **Marbury v. Madison.**

The 11th Amendment to the Constitution set aside the phrase *between a state and citizens of another state.* A citizen of one state cannot sue another state in a federal court.

(2) In all cases affecting ambassadors, other public ministers

and consuls, and those in which a state shall be party, the Supreme Court shall have original jurisdiction. In all the other cases before mentioned, the Supreme Court shall have appellate jurisdiction, both as to law and fact, with such exceptions, and under such regulations as the Congress shall make.

The statement that the Supreme Court has *original jurisdiction* in cases affecting the representatives of foreign countries and in cases to which a state is one of the parties means that cases of this kind go directly to the Supreme Court. In other kinds of cases, the Supreme Court has *appellate jurisdiction.* This means that the cases are tried first in a lower court and may come up to the Supreme Court for review if Congress authorizes an appeal. Congress cannot take away or modify the original jurisdiction of the Supreme Court. However, it can take away the right to appeal to the Supreme Court, or it can fix the conditions one must meet to present an appeal.

(3) The trial of all crimes, except in cases of impeachment, shall be by jury; and such trial shall be held in the state where the said crimes shall have been committed; but when not committed within any state, the trial shall be at such place or places as the Congress may by law have directed.

Section 3. **(1) Treason against the United States, shall consist only in levying war against them, or in adhering to their enemies, giving them aid and comfort. No person shall be convicted of treason unless on the testimony of two witnesses to the same overt act, or on confession in open court.**

No person can be convicted of treason against the United States unless he or she confesses in open court, or unless two witnesses testify that he or she has committed a treasonable act. Talking or thinking about committing a treasonable act is not treason. See **Treason**.

(2) The Congress shall have power to declare the punishment of treason, but no attainder of treason shall work corruption of blood, or forfeiture except during the life of the person attainted.

The phrase *no attainder of treason shall work corruption of blood* means that the family of a traitor does not share the guilt. Formerly, an offender's family could also be punished.

Article IV

Relation of the states to each other

Much of this article was taken word for word from the old Articles of Confederation.

Section 1. **Full faith and credit shall be given in each state to the public acts, records, and judicial proceedings of every other state. And the Congress may by general laws prescribe the manner in which such acts, records and proceedings shall be proved, and the effect thereof.**

This section requires the states to honor one another's laws, records, and court rulings. The rule prevents a person from avoiding justice by leaving a state.

Section 2. **(1) The citizens of each state shall be entitled to all privileges and immunities of citizens in the several states.**

This means that citizens traveling from state to state are entitled to all the privileges and immunities that automatically go to citizens of those states. Some privileges, such as the right to vote, do not automatically go with citizenship, but require a period of residence and perhaps other qualifications. The word *citizen* in this provision does not include corporations.

(2) A person charged in any state with treason, felony, or other crime, who shall flee from justice, and be found in another state, shall on demand of the executive authority of the state from which he fled, be delivered up, to be removed to the state having jurisdiction of the crime.

If a person commits a crime in one state and flees to another, the governor of the state in which the crime was committed can demand that the fugitive be handed over. Returning an accused person is called *extradition.* A few governors have refused to extradite, perhaps because the crime was committed many years ago, or because they believed the accused would not get a fair trial. It is not clear how the federal government could enforce this section. See **Extradition**.

(3) [No person held to service or labor in one state, under the laws thereof, escaping into another, shall, in consequence of any law or regulation therein, be discharged from such service or labor, but shall be delivered up on claim of the party to whom such service or labor may be due.]

A "person held to service or labor" was a slave or an *indentured servant* (a person bound by contract to serve someone for several years). No one is now bound to servitude in the United States, so this part of the Constitution no longer has any force, being overruled by the 13th Amendment.

Federal-state relations

Section 3. **(1) New states may be admitted by the Congress into this Union; but no new state shall be formed or erected within the jurisdiction of any other state; nor any state be formed by the junction of two or more states, or parts of states, without the consent of the legislatures of the states concerned as well as of the Congress.**

New states cannot be formed by dividing or joining existing states without the consent of the state legislatures and Congress. During the Civil War (1861-1865), Virginia fought for the Confederacy, but people in the state's western part supported the Union. After West Virginia split from Virginia, Congress accepted the new state on the ground that Virginia had rebelled.

(2) The Congress shall have power to dispose of and make all needful rules and regulations respecting the territory or other property belonging to the United States; and nothing in this Constitution shall be so construed as to prejudice any claims of the United States, or of any particular state.

Section 4. **The United States shall guarantee to every state in this Union a republican form of government, and shall protect each of them against invasion; and on application of the legislature, or of the executive (when the legislature cannot be convened) against domestic violence.**

This section requires the federal government to make sure that every state has a "republican form of government." A republican government is one in which the people elect representatives to govern. The Supreme Court ruled that Congress, not the courts, must decide whether a state government is republican. According to the court, if Congress admits a state's senators and representatives, that action indicates that Congress considers the state's government republican.

The legislature or governor of a state can request federal aid in dealing with riots or other violence. During the Pullman strike of 1894, federal troops were sent to Illinois even though the governor said he did not want them (see **Pullman strike**).

Article V

Amending the Constitution

The Congress, whenever two-thirds of both houses shall deem it necessary, shall propose amendments to this Constitution, or, on the application of the legislatures of two-thirds of the several states, shall call a convention for proposing amendments, which, in either case, shall be valid to all intents and purposes, as part of this Constitution, when ratified by the legislatures of three-fourths of the several states, or by conventions in three-fourths thereof, as the one or the other mode of ratification may be proposed by the Congress; provided [that no amendment which may be made prior to the year one thousand eight hundred and eight shall in any manner affect the first and fourth clauses in the ninth section of the first article; and] that no state, without its consent, shall be deprived of its equal suffrage in the Senate.

Amendments may be proposed by a two-thirds vote of each house of Congress or by a national convention called by Congress at the request of two-thirds of the states. A national convention has never been called, in part because there are no established procedures for operating such a meeting and because of fear that such a convention could result in vast and possibly dangerous changes. To become part of the Constitution, amendments must be *ratified* (approved) by the legislatures of three-fourths of the states or by conventions in three-fourths of the states.

The framers of the Constitution purposely made it hard to put through an amendment. Congress has considered more than 9,000 amendments, but it has passed only 33 and submitted them to the states. Of these, 27 have been ratified. Only one amendment, the 21st, was ratified by state conventions. All the others were ratified by state legislatures.

The Constitution sets no time limit during which the states must ratify a proposed amendment. Ratification of the 27th Amendment took 203 years, longer by far than that of any other amendment. The amendment was first proposed in 1789 and did not become part of the Constitution until 1992. Nevertheless, the courts have held that amendments must be ratified within a "reasonable time" and that Congress decides what is reasonable. Since the early 1900's, most amendments have included a requirement that ratification be obtained within seven years.

Article VI

National debts

(1) All debts contracted and engagements entered into, before the adoption of this Constitution, shall be as valid against the United States under this Constitution, as under the Confederation.

This section promises that all debts and obligations made by the United States before the adoption of the Constitution will be honored.

Supremacy of the national government

(2) This Constitution, and the laws of the United States which shall be made in pursuance thereof; and all treaties made, or which shall be made, under the authority of the United States, shall be the supreme law of the land; and the judges in every state shall be bound thereby, anything in the constitution or laws of any state to the contrary notwithstanding.

This section, known as the *supremacy clause,* has been called *the linchpin of the Constitution*—that is, the part that keeps the entire structure from falling apart. It means simply that when state laws conflict with national laws, the national laws are superior. It also means that, to be valid, a national law must follow the Constitution.

(3) The senators and representatives before mentioned, and the members of the several state legislatures, and all executive and judicial officers, both of the United States and of the several states, shall be bound by oath or affirmation, to support this Constitution; but no religious test shall ever be required as a qualification to any office or public trust under the United States.

This section requires both federal and state officials to give supreme allegiance to the Constitution of the United States rather than to any state constitution. The section also forbids any religious test for holding federal office. The 14th Amendment applies the same rule to state and local governments.

Article VII

Ratifying the Constitution

The ratification of the conventions of nine states, shall be sufficient for the establishment of this Constitution between the states so ratifying the same.

Done in convention by the unanimous consent of the states present the seventeenth day of September in the year of our Lord one thousand seven hundred and eighty-seven and of the independence of the United States of America the twelfth. In witness whereof we have hereunto subscribed our names,

George Washington—President and deputy from Virginia

Delaware
George Read
Gunning Bedford, Jr.
John Dickinson
Richard Bassett
Jacob Broom

Maryland
James McHenry
Daniel of St. Thomas Jenifer
Daniel Carroll

Virginia
John Blair
James Madison, Jr.

North Carolina
William Blount
Richard Dobbs Spaight
Hugh Williamson

South Carolina
John Rutledge
Charles Cotesworth Pinckney
Charles Pinckney
Pierce Butler

Georgia
William Few
Abraham Baldwin

New Hampshire
John Langdon
Nicholas Gilman

Massachusetts
Nathaniel Gorham
Rufus King

Connecticut
William Samuel Johnson
Roger Sherman

New York
Alexander Hamilton

New Jersey
William Livingston
David Brearley
William Paterson
Jonathan Dayton

Pennsylvania
Benjamin Franklin
Thomas Mifflin
Robert Morris
George Clymer
Thomas FitzSimons
Jared Ingersoll
James Wilson
Gouverneur Morris

Amendments to the Constitution

The Bill of Rights

The first 10 amendments, known as the Bill of Rights, *were proposed on Sept. 25, 1789. They were ratified on Dec. 15, 1791. They were adopted because some states refused to approve the Constitution unless a bill of rights was added.*

The amendments protect individuals from various unjust acts of government. Originally, the amendments applied only to the federal government. But the 14th Amendment declares that no state can deprive any person of life, liberty, or property without "due process of law." The Supreme Court has interpreted those words to mean that most of the Bill of Rights applies to the states as well. See ***Bill of rights***.

Amendment 1

Freedom of religion, speech, and the press; rights of assembly and petition

Congress shall make no law respecting an establishment of religion, or prohibiting the free exercise thereof; or abridging the freedom of speech, or of the press; or the right of the people peaceably to assemble, and to petition the government for a redress of grievances.

Many countries have made one religion the *established* (official) church and supported it with government funds. This amendment forbids Congress to set up or in any way provide for an established church. It has been interpreted to forbid government endorsement of, or aid to, religious doctrines. In addition, Congress may not pass laws limiting worship, speech, or the press, or preventing people from meeting peacefully. Con-

gress also may not keep people from asking the government for relief from unfair treatment.

All the rights protected by this amendment have limits. For example, the guarantee of freedom of religion does not mean that the government must allow all religious practices. In the 1800's, some Mormons believed it was a man's religious duty to have more than one wife. The Supreme Court ruled that Mormons had to obey the laws forbidding that practice. See Freedom of religion; Freedom of speech; Freedom of the press.

Amendment 2

Right to bear arms

A well-regulated militia, being necessary to the security of a free state, the right of the people to keep and bear arms shall not be infringed.

This amendment has been interpreted in two ways. Some people believe it gives ordinary citizens the right to possess firearms. Others believe it only gives each state the right to maintain its own militia.

Amendment 3

Housing of soldiers

No soldier shall, in time of peace be quartered in any house, without the consent of the owner, nor in time of war, but in a manner to be prescribed by law.

This amendment grew out of an old complaint against the British, who had forced people to take soldiers into their homes.

Amendment 4

Search and arrest warrants

The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures, shall not be violated, and no warrants shall issue, but upon probable cause, supported by oath or affirmation, and particularly describing the place to be searched, and the persons or things to be seized.

This measure does not forbid legal authorities to search, to seize goods, or to arrest people. It simply requires that in most cases the authorities obtain a search or arrest warrant from a judge by showing the need for it. If a warrant cannot be obtained, the search or arrest is permitted only if the state's need for evidence outweighs the individual's right to privacy. In addition, the search or arrest may not be carried out in an unreasonable manner. See Search warrant.

Amendment 5

Rights in criminal cases

No person shall be held to answer for a capital, or otherwise infamous crime, unless on a presentment or indictment of a grand jury, except in cases arising in the land or naval forces, or in the militia, when in actual service in time of war or public danger; nor shall any person be subject for the same offense to be twice put in jeopardy of life or limb; nor shall be compelled in any criminal case to be a witness against himself, nor be deprived of life, liberty, or property, without due process of law; nor shall private property be taken for public use, without just compensation.

A *capital crime* is one punishable by death. An *infamous crime* is one punishable by death or imprisonment. This amendment guarantees that no one has to stand trial for such a federal crime unless he or she has been *indicted* (accused) by a *grand jury*. A grand jury is a special group of people selected to decide whether there is enough evidence against a person to hold a trial. A person cannot be *put in double jeopardy* (tried twice) for the same offense by the same government. But a person may be tried a second time if a jury cannot agree on a verdict, if a mistrial is declared for some other reason, or if the person requests a new trial. The amendment also guarantees that people cannot be forced to testify against themselves.

The statement that no person shall be deprived of life, liberty, or property "without due process of law" expresses one of the most important rules of the Constitution. The same words are in the 14th Amendment as restrictions on the power of the states. The phrase expresses the idea that a person's life, liberty, and property are not subject to the uncontrolled power of the government. This idea can be traced to Magna Carta, which provided that the king could not imprison or harm a person "except by the lawful judgment of his peers or by the law of the land." Due process is a vague rule, and the Supreme Court has applied it to widely different cases. At one time, the court used the due-process rule to strike down laws that prevented people from using their property as they wished. In 1857, for example, the court overturned the Missouri Compromise, which prohibited slavery in certain U.S. territories. The court said the compromise unjustly prevented slave owners from taking slaves—their property—into the territories. Today, the courts use the rule to strike down laws that interfere with personal liberty. See Due process of law.

The amendment also forbids the government to take a person's property for public use without fair payment. The government's right to take property for public use is called *eminent domain.* Governments use it to acquire land for highways, schools, and other public facilities. See Fifth Amendment.

Amendment 6

Rights to a fair trial

In all criminal prosecutions, the accused shall enjoy the right to a speedy and public trial, by an impartial jury of the state and district wherein the crime shall have been committed, which district shall have been previously ascertained by law, and to be informed of the nature and cause of the accusation; to be confronted with the witnesses against him; to have compulsory process for obtaining witnesses in his favor, and to have the assistance of counsel for his defense.

A person accused of crime must have a prompt, public trial by an open-minded jury. The requirement for a speedy and public trial grew out of the fact that some political trials in England had been delayed for years and then were held in secret. Accused persons must be informed of the charges against them and must be allowed to meet the witnesses against them face to face. Otherwise, innocent individuals may be punished if a court allows the testimony of unknown witnesses to be used as evidence. This amendment guarantees that persons on trial can face and cross-examine those who have accused them. They may be able to show that their accusers lied or made a mistake. Finally, accused individuals must have a lawyer to defend them if they want one.

Amendment 7

Rights in civil cases

In suits at common law, where the value in controversy shall exceed twenty dollars, the right of a trial by jury shall be preserved, and no fact tried by a jury, shall be otherwise reexamined in any court of the United States, than according to the rules of the common law.

The framers of the Constitution considered the right to jury trial extremely important. In the Sixth Amendment, they provided for jury trials in criminal cases. In the Seventh Amendment, they provided for such trials in civil suits where the amount contested exceeds $20. The amendment applies only to civil cases in federal courts. But because of a great decline in the value of the dollar over the years, it now applies to almost all such cases. Most states also call for jury trials in civil cases.

Amendment 8

Bails, fines, and punishments

Excessive bail shall not be required, nor excessive fines imposed, nor cruel and unusual punishments inflicted.

Bails, fines, and punishments must be fair and humane. In the case of *Furman v. Georgia,* the Supreme Court ruled in 1972 that

capital punishment, as it was then imposed, violated this amendment. The court held that the death penalty was cruel and unusual punishment because it was not applied fairly and uniformly. Many states then adopted new laws designed to meet the court's objections. The court has ruled that the death penalty may be imposed if certain standards are applied to guard against its arbitrary use. See Capital punishment.

Amendment 9

Rights retained by the people

The enumeration in the Constitution, of certain rights, shall not be construed to deny or disparage others retained by the people.

Some people feared that the listing of some rights in the Bill of Rights would be interpreted to mean that other rights not listed were not protected. This amendment was adopted to prevent such an interpretation.

Amendment 10

Powers retained by the states and the people

The powers not delegated to the United States by the Constitution, nor prohibited by it to the states, are reserved to the states respectively, or to the people.

This amendment was adopted to reassure people that the national government would not swallow up the states. It confirms that the states or the people retain all powers not given to the national government. For example, the states have authority over such matters as marriage and divorce. But the Constitution says the federal government can make any laws "necessary and proper" to carry out its specific powers. This rule makes it hard to determine the exact rights of states.

Amendment 11

Lawsuits against states

This amendment was proposed on March 4, 1794, and ratified on Feb. 7, 1795. However, the amendment was not proclaimed until 1798 because of delays that occurred in certifying the ratification.

The judicial power of the United States shall not be construed to extend to any suit in law or equity, commenced or prosecuted against one of the United States by citizens of another state, or by citizens or subjects of any foreign state.

This amendment makes it impossible for a citizen of one state to sue another state in federal court. The amendment resulted from the 1793 case of *Chisholm v. Georgia,* in which a man from South Carolina sued the state of Georgia over an inheritance. Georgia argued that it could not be sued in federal court, but the Supreme Court ruled that the state could be. Georgia then led a movement to adopt this amendment. However, individuals can still sue state authorities in federal court for depriving them of their constitutional rights.

Amendment 12

Election of the President and Vice President

This amendment was proposed on Dec. 9, 1803, and ratified on July 27, 1804.

The electors shall meet in their respective states and vote by ballot for President and Vice President, one of whom, at least, shall not be an inhabitant of the same state with themselves; they shall name in their ballots the person voted for as President, and in distinct ballots the person voted for as Vice President, and they shall make distinct lists of all persons voted for as President, and of all persons voted for as Vice President, and of the number of votes for each, which lists they shall sign and certify, and transmit sealed to the seat of the government of the United States, directed to the president of the Senate;——the president of the Senate shall, in the presence of the Senate and House of Representatives, open all the certificates and the votes shall then be counted;——the person having the greatest number of votes for President, shall be the President, if such number be a majority of the whole number of electors appointed; and if no person have such majority, then from the persons having the highest numbers not exceeding three on the list of those voted for as President, the House of Representatives shall choose immediately, by ballot, the President. But in choosing the President, the votes shall be taken by states, the representation from each state having one vote; a quorum for this purpose shall consist of a member or members from two-thirds of the states, and a majority of all the states shall be necessary to a choice. And if the House of Representatives shall not choose a President whenever the right of choice shall devolve upon them, [before the fourth day of March next following,] then the Vice President shall act as President, as in the case of the death or other constitutional disability of the President.——The person having the greatest number of votes as Vice President, shall be the Vice President, if such number be a majority of the whole number of electors appointed, and if no person have a majority, then from the two highest numbers on the list, the Senate shall choose the Vice President; a quorum for the purpose shall consist of two-thirds of the whole number of senators, and a majority of the whole number shall be necessary to a choice. But no person constitutionally ineligible to the office of President shall be eligible to that of Vice President of the United States.

This amendment provides that members of the Electoral College, called *electors,* vote for one person as President and for another as Vice President. The amendment resulted from the election of 1800. At that time, each elector voted for two men, not saying which he wanted for President. The man who received the most votes became President, and the runner-up became Vice President. Thomas Jefferson, the presidential candidate, and Aaron Burr, the vice presidential candidate, received the same number of votes. The tie threw the election into the House of Representatives. The House chose Jefferson but took so long that people feared it would fail to choose before Inauguration Day. The House has chosen one other president—John Quincy Adams in 1825.

Amendment 13

Abolition of slavery

This amendment was proposed on Jan. 31, 1865, and ratified on Dec. 6, 1865.

***Section 1.* Neither slavery nor involuntary servitude, except as a punishment for crime whereof the party shall have been duly convicted, shall exist within the United States, or any place subject to their jurisdiction.**

President Abraham Lincoln's Emancipation Proclamation of 1863 had declared slaves free in the Confederate States still in rebellion. This amendment completed the abolition of slavery in the United States.

***Section 2.* Congress shall have power to enforce this article by appropriate legislation.**

Amendment 14

Civil rights

This amendment was proposed on June 13, 1866, and ratified on July 9, 1868.

***Section 1.* All persons born or naturalized in the United States, and subject to the jurisdiction thereof, are citizens of the United States and of the state wherein they reside. No state shall make or enforce any law which shall abridge the privileges or immunities of citizens of the United States; nor shall any state deprive any person of life, liberty, or property, without due process of law; nor deny to any person within its jurisdiction the equal protection of the laws.**

The principal purpose of this amendment was to make former slaves citizens of both the United States and the state in which they lived. The amendment also forbids the states to deny equal rights to any person. The terms of the amendment clarify how citizenship is acquired. State citizenship is a by-product of national citizenship. By living in a state, every U.S. citizen automatically becomes a citizen of that state as well. All persons *naturalized* (granted citizenship) according to law are U.S. citizens. People born in the United States are also citizens regardless of the nationality of their parents, unless they are diplomatic representatives of another country or enemies during a wartime occupation. Such cases are exceptions because the parents are not "subject to the jurisdiction" of the United States. The amendment does not grant citizenship to Indians on reservations, but Congress passed a law that did so.

The phrase "due process of law" has been ruled to forbid the states to violate most rights protected by the Bill of Rights. The statement that a state cannot deny anyone "equal protection of the laws" has provided the basis for many Supreme Court rulings on civil rights. For example, the court has outlawed segregation in public schools. The judges declared that "equal protection" means a state must make sure all children, regardless of race, have an equal opportunity for education.

Section 2. **Representatives shall be apportioned among the several states according to their respective numbers, counting the whole number of persons in each state, [excluding Indians not taxed]. But when the right to vote at any election for the choice of electors for President and Vice President of the United States, representatives in Congress, the executive and judicial officers of a state, or the members of the legislature thereof, is denied to any of the male inhabitants of such state, being twenty-one years of age, and citizens of the United States, or in any way abridged, except for participation in rebellion, or other crime, the basis of representation therein shall be reduced in the proportion which the number of such male citizens shall bear to the whole number of male citizens twenty-one years of age in such state.**

This section proposes a penalty for states which refuse to give the vote in federal elections to all adult male citizens. States which restrict voting can have their representation in Congress cut down. This penalty has never been used. The section has been set aside by the 19th and 26th amendments.

Section 3. **No person shall be a senator or representative in Congress, or elector of President and Vice President, or hold any office, civil or military, under the United States, or under any state, who, having previously taken an oath, as a member of Congress, or as an officer of the United States, or as a member of any state legislature, or as an executive or judicial officer of any state, to support the Constitution of the United States, shall have engaged in insurrection or rebellion against the same, or given aid or comfort to the enemies thereof. But Congress may by a vote of two-thirds of each House, remove such disability.**

This section's purpose was to keep federal officers who joined the Confederacy from becoming federal officers again. Congress could vote to overlook such a record.

Section 4. **The validity of the public debt of the United States, authorized by law, including debts incurred for payment of pensions and bounties for services in suppressing insurrection or rebellion, shall not be questioned. But neither the United States nor any state shall assume or pay any debt or obligation incurred in aid of insurrection or rebellion against the United States, or any claim for the loss of emancipation of any slave; but all such debts, obligations and claims shall be held illegal and void.**

This section ensured that the Union's Civil War debt would be paid, but voided all war debts run up by the Confederacy. The section also said that former slaveowners would not be paid for slaves who were freed.

Section 5. **The Congress shall have power to enforce, by appropriate legislation, the provisions of this article.**

Amendment 15

Black suffrage

This amendment was proposed on Feb. 26, 1869, and ratified on Feb. 3, 1870.

Section 1. **The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of race, color, or previous condition of servitude.**

Blacks who had been slaves became citizens under the terms of the 14th Amendment. The 15th Amendment does not specifically say that all blacks must be allowed to vote. The states are free to set qualifications for voters. But a voter cannot be denied the ballot because of race. Attempts by some states to do this indirectly have been struck down by Supreme Court decisions, federal and state laws, and the 24th Amendment. See **Fifteenth Amendment; Grandfather clause; Voting.**

Section 2. **The Congress shall have power to enforce this article by appropriate legislation.**

Amendment 16

Income taxes

This amendment was proposed on July 12, 1909, and ratified on Feb. 3, 1913.

The Congress shall have power to lay and collect taxes on incomes, from whatever source derived, without apportionment among the several states, and without regard to any census or enumeration.

In 1894, Congress passed an income tax law, but the Supreme Court declared it unconstitutional. This amendment authorized Congress to levy such a tax.

Amendment 17

Direct election of senators

This amendment was proposed on May 13, 1912, and ratified on April 8, 1913.

(1) The Senate of the United States shall be composed of two senators from each state, elected by the people thereof for six years; and each senator shall have one vote. The electors in each state shall have the qualifications requisite for electors of the most numerous branch of the state legislatures.

(2) When vacancies happen in the representation of any state in the Senate, the executive authority of such state shall issue writs of election to fill such vacancies: *Provided,* That the legislature of any state may empower the executive thereof to make temporary appointments until the people fill the vacancies by election as the legislature may direct.

(3) This amendment shall not be so construed as to affect the election or term of any senator chosen before it becomes valid as part of the Constitution.

This amendment takes the power of electing senators from the state legislatures and gives it to the people of the states.

Amendment 18

Prohibition of liquor

This amendment was proposed on Dec. 18, 1917, and ratified on Jan. 16, 1919.

Section 1. **After one year from the ratification of this article the manufacture, sale, or transportation of intoxicating liquors within, the importation thereof into, or the exportation thereof from the United States and all territory subject to the jurisdiction thereof for beverage purposes is hereby prohibited.**

Section 2. **The Congress and the several states shall have concurrent power to enforce this article by appropriate legislation.**

Section 3. **This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of the several states, as provided in the Constitution, within seven years from the date of the submission hereof to the states by the Congress.**

This is the prohibition amendment, which forbade people to make, sell, or transport liquor. It was widely ignored by the people and was repealed by the 21st Amendment in 1933.

Amendment 19

Woman suffrage

This amendment was proposed on June 4, 1919, and ratified on Aug. 18, 1920.

Section 1. **The right of citizens of the United States to vote shall not be denied or abridged by the United States or by any state on account of sex.**

Section 2. **Congress shall have power to enforce this article by appropriate legislation.**

Amendments giving women the right to vote were introduced in Congress one after another for more than 40 years before this one was finally passed.

Amendment 20

Terms of the President and Congress

This amendment was proposed on March 2, 1932, and ratified on Jan. 23, 1933.

Section 1. **The terms of the President and Vice President shall end at noon on the 20th day of January, and the terms of senators and representatives at noon on the third day of January, of the year in which such terms would have ended if this article had not been ratified; and the terms of their successors shall then begin.**

Section 2. **The Congress shall assemble at least once in every year, and such meeting shall begin at noon on the third day of January, unless they shall by law appoint a different day.**

Section 3. **If, at the time fixed for the beginning of the term of the President, the President elect shall have died, the Vice President elect shall become President. If a President shall not have been chosen before the time fixed for the beginning of his term, or if the President elect shall have failed to qualify, then the Vice President elect shall act as President until a President shall have qualified; and the Congress may by law provide for the case wherein neither a President elect nor a Vice President elect shall have qualified, declaring who shall then act as President, or the manner in which one who is to act shall be selected, and such person shall act accordingly until a President or Vice President shall have qualified.**

Section 4. **The Congress may by law provide for the case of the death of any of the persons from whom the House of Representatives may choose a President whenever the right of choice shall have devolved upon them, and for the case of the death of any of the persons from whom the Senate may choose a Vice President whenever the right of choice shall have devolved upon them.**

Section 5. **Sections 1 and 2 shall take effect on the 15th day of October following the ratification of this article.**

Section 6. **This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of three-fourths of the several states within seven years from the date of its submission.**

This *lame duck amendment* moves the date that newly elected Presidents and members of Congress take office closer to election time. A *lame duck* is an official who continues to serve though not reelected. Before the amendment came into force, defeated members of Congress continued to hold office for four months. See Lame duck amendment.

Amendment 21

Repeal of prohibition

This amendment was proposed on Feb. 20, 1933, and ratified on Dec. 5, 1933.

Section 1. **The eighteenth article of amendment to the Constitution of the United States is hereby repealed.**

Section 2. **The transportation or importation into any state, territory, or possession of the United States for delivery or use therein of intoxicating liquors, in violation of the laws thereof, is hereby prohibited.**

Section 3. **This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by conventions in the several states, as provided in the Constitution, within seven years from the date of the submission hereof to the states by the Congress.**

This amendment repeals the 18th Amendment. Section 2 promises federal help to "dry" states in enforcing their own laws.

Amendment 22

Limitation of Presidents to two terms

This amendment was proposed on March 24, 1947, and ratified on Feb. 27, 1951.

Section 1. **No person shall be elected to the office of the President more than twice, and no person who has held the office of President, or acted as President, for more than two years of a term to which some other person was elected President shall be elected to the office of the President more than once. But this article shall not apply to any person holding the office of President when this article was proposed by the Congress, and shall not prevent any person who may be holding the office of President, or acting as President, during the term within which this article becomes operative from holding the office of President or acting as President during the remainder of such term.**

Section 2. **This article shall be inoperative unless it shall have been ratified as an amendment to the Constitution by the legislatures of three-fourths of the several states within seven years from the day of its submission to the states by the Congress.**

This amendment provides that no person can be elected President more than twice. Nobody who has served for more than two years of someone else's term can be elected more than once. A President can hold office for no more than 10 years. The amendment was supported by those who thought Franklin D. Roosevelt should not serve four terms. No other President had run for election to more than two consecutive terms.

Amendment 23

Suffrage in the District of Columbia

This amendment was proposed on June 16, 1960, and ratified on March 29, 1961.

Section 1. **The district constituting the seat of government of the United States shall appoint in such manner as the Congress may direct: A number of electors of President and Vice**

president equal to the whole number of senators and representatives in Congress to which the district would be entitled if it were a state, but in no event more than the least populous state; they shall be in addition to those appointed by the states, but they shall be considered, for the purposes of the election of president and vice president, to be electors appointed by a state; and they shall meet in the district and perform such duties as provided by the twelfth article of amendment.

Section 2. **The Congress shall have power to enforce this article by appropriate legislation.**

This amendment allows citizens of the District of Columbia to vote in presidential elections. However, they cannot vote for members of Congress.

Amendment 24

Poll taxes

This amendment was proposed on Aug. 27, 1962, and ratified on Jan. 23, 1964.

Section 1. **The right of citizens of the United States to vote in any primary or other election for president or vice president, for electors for president or vice president, or for senator or representative in Congress, shall not be denied or abridged by the United States or any state by reason of failure to pay any poll tax or other tax.**

Section 2. **The Congress shall have power to enforce this article by appropriate legislation.**

This amendment forbids making voters pay a *poll tax* before they can vote in a national election. A poll tax, also called a *head tax,* is a tax collected equally from everyone. Some states once used such taxes to keep poor people and blacks from voting. The term *poll tax* does not mean a tax on voting. It comes from the old English word *poll,* meaning *head.* See **Poll tax.**

Amendment 25

Presidential disability and succession

This amendment was proposed on July 6, 1965, and ratified on Feb. 10, 1967.

Section 1. **In case of the removal of the president from office or of his death or resignation, the vice president shall become president.**

Section 2. **Whenever there is a vacancy in the office of the vice president, the president shall nominate a vice president who shall take office upon confirmation by a majority vote of both houses of Congress.**

This section provides for filling a vacancy in the vice presidency. In 1973, Gerald R. Ford became the first person chosen vice president under this provision. He was nominated by President Richard M. Nixon after Vice President Spiro T. Agnew resigned. In 1974, Nixon resigned and Ford became president. Nelson A. Rockefeller then became vice president under the new procedure. For the first time, the nation had both a president and vice president who had not been elected to their office. Before this amendment came into force, vacancies in the vice presidency remained unfilled until the next election.

Section 3. **Whenever the president transmits to the president pro tempore of the Senate and the speaker of the House of Representatives his written declaration that he is unable to discharge the powers and duties of his office, and until he transmits to them a written declaration to the contrary, such powers and duties shall be discharged by the vice president as acting president.**

This section provides that the vice president succeeds to the presidency if the president becomes disabled. Vice President George H. W. Bush became the first acting president. He officially held the position eight hours on July 13, 1985, when President Ronald Reagan had cancer surgery.

Section 4. **Whenever the vice president and majority of either the principal officers of the executive departments or of such other body as Congress may by law provide, transmit to the president pro tempore of the Senate and the speaker of the House of Representatives their written declaration that the president is unable to discharge the powers and duties of his office, the vice president shall immediately assume the powers and duties of the office as acting president.**

Thereafter, when the president transmits to the president pro tempore of the Senate and the speaker of the House of Representatives his written declaration that no inability exists, he shall resume the powers and duties of his office unless the vice president and a majority of either the principal officers of the executive department or of such other body as Congress may by law provide, transmit within four days to the president pro tempore of the Senate and the speaker of the House of Representatives their written declaration that the president is unable to discharge the powers and duties of his office. Thereupon Congress shall decide the issue, assembling within forty-eight hours for that purpose if not in session. If the Congress, within twenty-one days after receipt of the latter written declaration, or, if Congress is not in session, within twenty-one days after Congress is required to assemble, determines by two-thirds vote of both houses that the president is unable to discharge the powers and duties of his office, the vice president shall continue to discharge the same as acting president; otherwise, the president shall resume the powers and duties of his office.

Amendment 26

Suffrage for 18-year-olds

This amendment was proposed on March 23, 1971, and ratified on July 1, 1971.

Section 1. **The right of citizens of the United States, who are eighteen years of age or older, to vote shall not be denied or abridged by the United States or by any state on account of age.**

Section 2. **The Congress shall have power to enforce this article by appropriate legislation.**

This amendment grants the vote to citizens 18 years of age or older. Passed during the Vietnam War, it reflected the opinion of many people of the time that young men who are old enough to be drafted into the armed forces should be able to vote for or against officials who lead the nation into war.

Amendment 27

Congressional salaries

This amendment was proposed on Sept. 25, 1789, and ratified on May 7, 1992.

No law varying the compensation for the services of the senators and representatives shall take effect, until an election of representatives shall have intervened.

This amendment prevents Congress from passing immediate salary increases for itself. It requires that salary changes passed by Congress cannot take effect until after the next congressional election. It had been passed in 1789 and sent to the states for ratification. The amendment had no time limit for ratification. It became part of the Constitution in 1992, after Michigan became the 38th state to ratify it. Annotations by Bruce Allen Murphy

Constitutional Convention. See Constitution of the United States (The Constitutional Convention).

Constitutional Union Party was an American political party formed in 1859 by former members of the Whig and Know-Nothing parties. At a convention in Baltimore in 1860, the party nominated John Bell and Ed-

ward Everett for president and vice president. The candidates lost, and the party died out. See also Whig Party; Bell, John. David Herbert Donald

Construction, Building. See Building construction.

Consul, *KAHN suhl,* is an official appointed by the government of one country to look after its commercial and cultural interests in a city of another country. A consul differs from a diplomatic representative. A consul attends primarily to business and cultural matters, while a diplomat is interested primarily in political relations (see Ambassador).

United States consuls issue birth, death, and marriage certificates to Americans temporarily within their jurisdiction, regulate shipping, and aid U.S. citizens who are traveling abroad. For example, they assist American tourists who are arrested or robbed in a foreign country. They may also issue visas to foreigners traveling to the United States.

The consular service of any leading country is divided into three ranks: consuls-general, consuls, and commercial agents. The consuls-general have charge of all consuls in a district. The commercial agents, although they have the same duties and powers as consuls, are not officially recognized by the government. The powers and duties of consuls are often determined by treaty.

The title *consul* was given to the two highest magistrates of the Roman republic during ancient times. The insignia were the purple-bordered toga, a staff of ivory, and an ornamental chair. The title, without the function, was retained under the empire. During the French Republic, from 1799 to 1804, the three chief magistrates were consuls. Napoleon Bonaparte, the first consul, held all the real power. Robert J. Pranger

See also Foreign Service.

Consumer Affairs, United States Office of, is an agency of the U.S. government. It analyzes and coordinates all government activities in the field of consumer protection. The office serves chiefly in an advisory and informational role. It does not have the authority to enforce specific laws that protect consumers.

President Richard M. Nixon created the office in 1971. It succeeded the president's Committee on Consumer Interests, which President Lyndon B. Johnson had created in 1964. In 1973, the administrative functions of the office were transferred from the Executive Office of the President to the Department of Health, Education, and Welfare (now the Department of Health and Human Services). The director of the agency serves the president as Special Adviser for Consumer Affairs.

Critically reviewed by the United States Office of Consumer Affairs

Consumer Federation of America (CFA) is an organization that promotes the interests of consumers in the United States. It is a federation of about 250 church, consumer, farm, and labor groups. These national, state, and local organizations have joined together to influence public policy as it is formulated by Congress, regulatory agencies, and the courts.

The federation operates a foundation that sponsors research and educates the public on such consumer concerns as product safety and inflation. CFA publications include *CFAnews* and *Indoor Air News.* The federation was established in 1968. The headquarters of the Consumer Federation of America are in Washington, D.C. Critically reviewed by the Consumer Federation of America

Consumer Price Index is a measurement of changes in the prices of goods and services bought by most people in the United States. The index, also called the CPI, compares the present cost of more than 200 types of goods and services with their cost at an earlier time.

The CPI is the chief measurement of *inflation* (rising prices) in the United States. Employers use the CPI to determine wage and benefits increases, and the government uses it to calculate Social Security benefits. As a result, the CPI affects the income of nearly half the people of the United States. The Federal Reserve System, the agency that oversees U.S. banking, also considers the CPI as it raises and lowers interest rates.

The CPI is prepared by the Bureau of Labor Statistics (BLS), a government agency. The bureau gathers data on costs of such things as food, clothing, housing, medical care, transportation, computers, dining out, and entertainment from thousands of sources in dozens of cities.

There are two main forms of the CPI. The form most widely used reflects monthly and yearly spending by urban wage earners and clerical workers. The other shows spending by all consumers except those in rural areas, the military, and institutions. The BLS also publishes indexes for areas with large populations, regions of the United States, and groups of cities classified by size.

In the 1990's, the BLS changed how it calculated the CPI in response to charges that the index exaggerated inflation. New methods take into account quality improvements, which often make up for a product's higher price. The bureau also began to consider how people substitute some goods and services for others as prices vary. If the cost of parking increases, for example, more people might use public transportation. Daniel Kadlec

See also Cost of living; Inflation.

Consumer Product Safety Commission is an independent agency of the United States government. It works to protect consumers from unsafe products that can cause illness, injury, or even death.

The commission promotes the development of voluntary safety standards by manufacturers. It also establishes and enforces uniform federal safety standards for the content, construction, and performance of consumer products. The commission has authority over more than 15,000 manufactured goods, including appliances, baby clothes, gardening tools, sports equipment, and toys. Cars, cosmetics, drugs, and food are regulated by other agencies. But the commission regulates the packaging of some of these products to ensure that children cannot open them easily.

The commission can order the recall, repair, or replacement of products that it considers hazardous. It has the authority to seize especially dangerous products or to forbid their sale. The agency conducts research on the causes and prevention of accidents associated with consumer products. It also conducts programs to help educate the public about product safety.

Congress created the commission in 1972. The president appoints the five members to seven-year terms, subject to the approval of the Senate.

Critically reviewed by the Consumer Product Safety Commission

Consumerism is a movement that promotes the interests of buyers of goods and services. It works to protect consumers from unsafe products; fraudulent advertising, labeling, or packaging; and business practices

that limit competition. Consumerism, also known as *consumer protection* or the *consumer movement,* is active in many countries. This article discusses the movement in the United States.

Consumerism includes activities by consumers themselves, as well as government action on the federal, state, and local level. The movement seeks to provide adequate information about products so that consumers can make wise decisions in purchasing goods and services. Consumerism also tries to inform consumers of effective means of obtaining compensation for damage or injury caused by defective products.

The rise of the consumer movement has had major effects on business and industry. Many companies have become more responsive to the needs, wants, and safety of consumers. Other firms have not been responsive to these concerns. Some of them have experienced financial losses and unfavorable publicity resulting from lawsuits by dissatisfied consumers and government-ordered recalls of defective products.

The consumer's rights

Consumer groups and many other people believe consumers have several basic rights. For example, they believe consumers are entitled to (1) products whose quality is consistent with their prices and the claims of manufacturers; (2) protection against unsafe goods; (3) truthful, adequate information about goods or services; and (4) a choice among a variety of products. Buyers also have certain responsibilities. For example, they must use a product for the purpose intended by the manufacturer, and they should follow the instructions provided with the product.

The right to quality. Warranties and money-back guarantees provide assurances that a product will live up to the claims of the manufacturer. Most warranties are written statements that promise repair, replacement, or a refund if a product fails to perform as the manufacturer said it would for a certain period of time. A money-back guarantee promises a refund of the purchase price if the buyer is not completely satisfied.

The Magnuson-Moss Warranty Act of 1975 helps regulate warranties. This law requires that warranties be written clearly so they can be easily understood by the public. The act also gives the consumer the right to an *implied warranty* if the manufacturer does not provide a written warranty. An implied warranty is an unwritten guarantee that a product is suitable for the purpose for which it has been sold. For example, a hairdrier should dry hair. Only a product sold "as is" has no implied warranty. Such goods include damaged and second-hand items.

The right to safety. A number of agencies of the federal government play an important role in ensuring the safety of goods. For example, the Food and Drug Administration (FDA) enforces laws concerning the safety of food, drugs, and cosmetics. The Consumer Product Safety Commission sets safety standards for many household products. The National Highway Traffic Safety Administration sets and enforces safety requirements for automobiles and related products. All such agencies test products and inspect factories. They also investigate consumer complaints and furnish information about product safety. In addition, the agencies can order manufacturers to recall hazardous products.

Certification programs give consumers further information about product safety. For example, Underwriters Laboratories, Inc., a nonprofit organization, sets safety standards for building materials, electric appliances, and other products. It tests products submitted by manufacturers and awards a certifying seal to items that meet its standards.

Consumers can seek compensation in several ways for a loss or injury. For example, a person can sue by means of a *product liability suit* or a *malpractice suit.* A product liability suit is brought against a manufacturer or seller for damage or injury that is caused by a product. A malpractice suit is filed against an individual or a company in a service field, such as medicine or dentistry.

Consumers can file individual lawsuits in a regular court, or they can bring their claims to a *small-claims court.* Most small-claims courts handle consumer complaints involving up to $5,000. If many consumers have the same complaint, they may file their claims in a single lawsuit called a *class action suit.*

People can also bring their complaints to consumer and business organizations. For example, many business companies finance organizations known as *better business bureaus.* The bureaus bring consumer complaints to the attention of business firms. Large numbers of companies have special departments that handle consumer problems. In addition, newspapers publish special columns and radio and television stations broadcast programs that tell consumers how to make complaints.

The right to information. Advertising provides a major method by which manufacturers and sellers give information to consumers. The Federal Trade Commission (FTC) regulates advertising and administers several programs that handle deceptive claims. For example, the FTC may order a manufacturer to provide *corrective advertising* if misleading claims have been made.

The FTC and the state governments fight *bait-and-switch selling* and other deceptive sales methods. A bait-and-switch advertisement uses a special sale on a product as "bait" to attract customers to the advertiser's place of business. Salespeople then try to "switch" the customers to a more expensive product.

Various laws protect the consumer's right to adequate, truthful information. One of these laws is the Consumer Credit Protection Act of 1968, often called the Truth in Lending Act. It requires sellers to state clearly the charge made for loans and installment purchases and to express the interest rate as an annual rate. Another law affecting information given consumers is the Fair Packaging and Labeling Act of 1966, also known as the Truth in Packaging and Labeling Act. It requires that the package used for a product provide certain information. This information includes the identity of the product, the manufacturer's name and address, and the net quantity of the contents.

The United States Department of Agriculture requires that the grade of meat and dairy products appear on those items for the benefit of consumers. Many food stores use *unit pricing,* such as the price per ounce or per gram. This system helps consumers determine the best buy among several products in different sizes of packages. Food manufacturers also inform consumers

by *freshness labeling,* also called *open dating.* A product is stamped with a date, which is the last day that it should be sold or used to assure quality or freshness.

Consumer organizations contribute much information about products. For example, Consumers' Research, Inc., and Consumers Union test a wide variety of products and publish the results. Consumers' Research is financed entirely by consumers who subscribe to its publications, and Consumers Union is supported chiefly by the sale of subscriptions, plus some contributions. Consumer groups also encourage the development of consumer education programs. Such programs emphasize the rights of consumers and provide information about managing money and making wise purchases.

The right to choose. The government regulates business in order to promote free and fair competition. The Sherman Antitrust Act of 1890 forbids monopolies. The act also prohibits *price fixing,* a stated or implied agreement by several manufacturers to charge a noncompetitive price for a product they all make. The U.S. Department of Justice and the FTC enforce the Sherman Act. The FTC also enforces the Clayton Antitrust Act of 1914 and the Celler-Kefauver Act of 1950. These laws are designed to prohibit businesses from forming combinations that would reduce competition.

Some supporters of consumerism favor regulation by the FTC of the amount of money that businesses spend for advertising. They argue that small or new companies cannot spend large sums for advertising and thus cannot compete with large or older firms. As a result, businesses with larger budgets have considerable control over the market and the prices that consumers pay.

History of the consumer movement

Early buyer-seller relationships. Some of the first attempts to protect consumers occurred during the Middle Ages. Guilds established by craftworkers set standards for products sold by their members. Another form of early consumer protection consisted of laws against *usury,* the lending of money at an excessive rate of interest. These laws regulated the rate of interest that moneylenders could charge borrowers.

Beginnings of consumerism. During the late 1800's and early 1900's, the sale of many impure and unsafe products led to increased consumer interest in legislation that established standards of quality. A number of writers called *muckrakers* exposed abuses by various companies. For example, the novelist Upton Sinclair wrote *The Jungle* (1906), which described filthy conditions in the meat-packing industry. This book helped lead to the federal Food and Drugs Act of 1906.

The growth of large corporations and monopolies also contributed to an increased interest in consumerism. These giant business companies lacked competition from other firms, and so they regulated the supply of products and charged high prices. They also marketed many low-quality products. In the late 1800's, Congress passed the first antitrust and antimonopoly laws to protect consumers from these powerful companies.

As business and industry expanded, changes in technology resulted in new and increasingly complex products. Businesses also began to advertise extensively to distinguish their products from those of other companies. As a result, the consumer movement began to emphasize the customer's right to have adequate information about products. In 1929, Consumers' Research, Inc., was established to provide testing and rating services for consumers. A group of employees from that organization formed Consumers Union in 1936.

Growth of the movement. During the 1950's and 1960's, consumer awareness increased as a result of efforts by various crusaders. The author Vance Packard, in his books *The Hidden Persuaders* (1957) and *The Wastemakers* (1960), discussed sales promotion methods and certain techniques designed to increase the use of products. One of these techniques was the use of advertising to encourage people to desire various items. Ralph Nader, a leading consumer crusader, argued in *Unsafe at Any Speed* (1965) that many kinds of cars were unsafe. His book led to the National Traffic and Motor Vehicle Safety Act of 1966, which established safety standards for motor vehicles. Nader and his group of investigators, often called Nader's Raiders, also increased consumer interest in the safety of other products.

During the 1970's, a period of inflation, consumers became increasingly effective in exercising their rights. Inflation helped the growth of consumerism because of greater public concern about the cost and quality of products when prices go up continually. Consumer boycotts of beef, coffee, and sugar succeeded in temporarily lowering the prices of those products in the mid-1970's. During the 1980's, increased concern for health led consumers to demand more nutritional information on food packaging.

Today, consumer groups play a larger role than ever before in supporting the rights of consumers. For example, the Consumer Federation of America (CFA) presents the viewpoints of consumers to federal agencies. Public Citizen, an organization founded by Ralph Nader, conducts research on products, works to influence Congress and state legislatures, and develops educational programs for consumers. The Conference of Consumer Organizations provides assistance in organizing consumer groups. Barbara B. Murray

Related articles. Most of the federal agencies discussed in this article have separate articles in ***World Book.*** See also:

Advertising (Regulation of advertising)
Better business bureau
Center for Science in the Public Interest
Clothing (Protecting the public)
Consumer Affairs, United States Office of
Consumer Federation of America
Consumers Union
Interstate Commerce Commission
Meat packing (U.S. government inspection)
Monopoly and competition
Nader, Ralph
National Consumers League
Packaging
Product liability suit
Pure food and drug laws
Securities and Exchange Commission
Sinclair, Upton
Tarbell, Ida M.
Telemarketing
Textile (The textile industry)

Additional resources

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Consumer Sourcebook. Gale Group, published annually.

Krohn, Lauren. *Consumer Protection and the Law.* ABC-Clio, 1995.

Norrgard, Lee E. and Julia M. *Consumer Fraud: A Reference Handbook.* ABC-Clio, 1998.

Consumers League, National. See National Consumers League.

Consumers Union is an independent, nonprofit organization that tests and rates products and consumer services. Its full name is Consumers Union of United States. Consumers Union evaluates such things as appliances, machinery, food products, and insurance policies. It also calls attention to what it considers unsafe products, failures by government regulatory agencies, and weaknesses in consumer protection laws. Consumers Union sometimes files lawsuits on behalf of consumer interests.

The organization reports on its tests in *Consumer Reports,* its monthly magazine. Each issue of the magazine includes articles designed to help consumers spend money wisely and to inform them about consumer issues. In addition, Consumers Union publishes books on subjects of interest to consumers and provides information to the public through newspapers, newsletters, radio, and television.

To maintain its reputation for fairness, Consumers Union does not accept advertising in any of its publications and does not accept samples or other gifts from any business interest. Consumers Union was established in 1936. It has offices in Mount Vernon, N.Y.

Critically reviewed by the Consumers Union of United States

Consumption, a disease. See **Tuberculosis.**

Consumption, *kuhn SUHMP shuhn,* in economics, is the use of goods and services to satisfy needs and desires. Most business activity is aimed at providing goods and services for consumption. Examples of consumption include eating food, wearing clothing, and using soap. People who use goods and services are *consumers.*

The value of goods and services that a family consumes depends almost entirely on its income and wealth. Americans spend more than 95 per cent of their *after-tax income* on consumer goods and services. After-tax income is the amount of yearly income that remains after income taxes and other taxes have been paid.

Families with low incomes tend to spend a larger part of their earnings for essentials such as food and housing than do families with higher incomes. Those with the lowest incomes spend more than they earn and are forced into debt. As incomes rise, families tend to spend a larger part of their earnings for such items as clothing, education, and entertainment. John Maynard Keynes, a noted British economist, was one of the first to emphasize that the general level of consumption in an economy helps determine the general level of income (see **Keynes, John Maynard**).

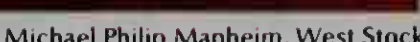
About two-thirds of all the goods and services produced in the United States each year are used by consumers. The remaining third is used by the government or invested in buildings, manufacturing machinery, and other forms of capital in the United States or other countries. In the United Kingdom, consumers also use about two-thirds of the goods and services produced.

Henry J. Aaron

Related articles in *World Book* include:

Consumerism	Production
Economics (Consumers)	Standard of living
Income	Trade (Trade in the United States)
Marketing	

Contact lens is a device used to correct an eye's nearsightedness or farsightedness. Contact lenses can be made of hard or soft plastic. They float on a thin layer of tears on the surface of the *cornea* (clear front surface of the eyeball). Contact lenses are curved to focus light rays on the retina. When the light rays are properly focused, a person sees clear images of normal size. Contact lenses provide more natural vision than glasses because they also allow normal side vision.


Michael Philip Manheim, West Stock — WORLD BOOK photo by Dan Miller

Contact lenses float on the eye's natural tear layer, *above right.* Balanced on the tip of a finger, *above left,* the lenses can be placed on the eye.

Most people wear contact lenses instead of glasses to look better and to feel more confident. Athletes and other active people like contact lenses because the lenses are less obstructive than glasses.

Hard contact lenses came into use in the early 1950's. They are made of rigid plastic and are relatively easy to clean and sterilize. Hard contact lenses that allow oxygen to pass through to the eye are called *gas permeable contact lenses.* These lenses are produced from special plastic. For many wearers, gas permeable contact lenses are more comfortable than normal hard contact lenses. Hard contact lenses are useful in correcting such eye disorders as *keratoconus* and *astigmatism.* These are conditions caused by a misshapen cornea.

Soft contact lenses originated in the early 1970's. They are softer and larger than hard contact lenses. Soft contact lenses absorb moisture and contain water. This composition enables the lenses to bend easily and makes them more comfortable than hard contact lenses. Originally it was necessary to remove soft contact lenses from the eye once a day. Now a type of soft contact lenses called *extended-wear contact lenses* can be worn on the eye without removal for up to seven days.

Soft contact lenses are more likely to cause infection than other types of contact lenses because impurities or bacteria may get into the water in the lenses. To avoid infection, wearers of soft contact lenses must regularly and thoroughly clean them in a special solution and sterilize them. A type of extended-wear contact lenses called *disposable contact lenses* can be worn for a week and then discarded and replaced with new ones. These lenses do not require cleaning or sterilizing.

Special types of contact lenses have been developed for unique needs. People with normal vision who want to change the color of their eyes may buy contact lenses that come in different colors and that do not alter vision. Some soft contact lenses are used to treat diseases. They contain medicine that is gradually released to the eye.

Both hard and soft contact lenses have been developed for use as bifocal contact lenses. These lenses are designed to help people who have trouble seeing both

at a distance and close up. They are made to replace bifocal glasses. Wearers look through one part of the lenses to see in the distance and through another part to see close up. The success rate of bifocal contact lenses remains limited for various reasons.

Monovision contact lenses offer another way to correct a problem with near and distant vision. A wearer uses a lens in one eye for close vision and one in the other eye for distant vision. Monovision lenses allow only one eye to be used at a time, and wearers sacrifice some depth perception. Robert O. Graham

Containerization is a method of transporting cargo by packing it into large containers. This cargo then can be moved as a unit by ship, truck, airplane, or railroad, and from one type of transportation to another. Containerization reduces the time and cost required to load and unload cargo.

Most shipping containers are made of steel. They can carry *general cargo*—that is, anything that can be packaged or that forms a package in itself. Containers also handle hazardous goods and cargo requiring refrigeration or tanks. Most major ports have special cranes that lift containers on and off ships. A container's size depends on its cargo. But most containers measure from 20 to 40 feet (6.1 to 12.2 meters) long and 8 to 9 $\frac{1}{2}$ feet (2.4 to 2.9 meters) high. Containers transported by air may be smaller. Containerization was first used in 1956. Ships built especially to handle containers are called *cellular vessels* or *container ships.* Today, about 90 percent of the world's general cargo moves by containerization.

Barbara Yeninas

See also **Freight**; **Ship** (Container ships); **Railroad** (Freight service).



Cameramann International, Ltd. from Marilyn Gartman

Containers of products are removed from storage, *shown here,* and loaded onto ships or railroad cars for shipment.

Contempt, in law, is willful disregard or disobedience of public authority, such as a court or legislative assembly. Contempt is usually shown by failure to obey specific demands, or by insults. Such acts are intended to challenge or reduce public authority and dignity. There are two kinds of contempt of court: those committed in a court, which disturb or interrupt its proceedings, and those that result from a refusal to comply with an order of the court. Both are punishable by fine or imprisonment. See also **Attachment.** James O. Finckenauer

Continent is a part of the earth's surface that forms one of the great dry-land masses of the world. It usually has extensive plains or plateaus and one or more mountain ranges, and is surrounded or nearly surrounded by water. The continents of the world are Asia (16,992,000 square miles, or 44,008,000 square kilometers); Africa (11,657,000 square miles, or 30,190,000 square kilometers); North America (9,347,000 square miles, or 24,208,000 square kilometers); South America (6,899,000 square miles, or 17,868,000 square kilometers); Antarctica (5,400,000 square miles, or 14,000,000 square kilometers); Europe (4,015,000 square miles, or 10,398,000 square kilometers); and Australia (2,989,000 square miles, or 7,741,000 square kilometers). Technically, Europe is not a continent, but a peninsula of Asia. It is part of what may be called the Eurasian continent, which has a total area of 21,006,000 square miles (54,406,000 square kilometers). The islands that make up the Pacific Islands, or Oceania, are not part of any continent. They have an area of about 487,000 square miles (1,262,000 square kilometers). Frederick A. Cook

See the articles in *World Book* for each continent. See also **World** (graphs: Facts about the continents).

Continental Association was an agreement adopted by the First Continental Congress of the American Colonies on Oct. 20, 1774. It was designed to defend American rights. The chief provisions were that each colony would (1) stop importing all British and Irish goods and some foreign and West Indian products by Dec. 1, 1774; (2) halt participation in the slave trade effective Dec. 1, 1774; (3) stop consumption of all British and Irish goods and some foreign and West Indian products by March 1, 1775; (4) stop all exports to Britain, Ireland, and the West Indies beginning Sept. 10, 1775; and (5) appoint committees to report violations.

William Morgan Fowler, Jr.

Continental Congress was a convention of delegates from the American Colonies that first met in Philadelphia on Sept. 5, 1774. The meeting grew out of a desire for unity that had spread through the colonies. All the colonies had seen danger to themselves in certain acts of the British Parliament aimed against Massachusetts, especially the Boston Port Act and the Massachusetts Government Act. See **Intolerable Acts.**

The First Continental Congress was attended by 56 delegates representing 12 colonies. Georgia sent no delegates but agreed to support any plans made at the meeting. Leaders of the Congress included Samuel Adams, George Washington, Peyton Randolph, Patrick Henry, Richard Henry Lee, John Adams, John Jay, Joseph Galloway, and John Dickinson. Peyton Randolph of Virginia was chosen president of the Congress, and each of the 12 colonies had equal voting power.

The first Congress sought fair treatment from Britain rather than independence. It set forth the position of the colonies toward taxation and trade in a Declaration of Rights, adopted on Oct. 14, 1774. The Congress declared that Parliament had no right to pass laws that affected America, except possibly in the area of foreign



Oil painting on canvas (begun late 1700's) by Robert E. Pine and Edward Savage; Historical Society of Pennsylvania, Philadelphia

The Second Continental Congress adopted the Declaration of Independence on July 4, 1776. This painting shows members of the Congress voting in Independence Hall in Philadelphia.

trade. It claimed the right of each colonial assembly to regulate its own internal affairs.

Probably the boldest act of the Congress was to set up the Continental Association, which bound the colonists not to trade with Britain or use British goods until British trade and taxation policies had changed. The delegates planned to hold another Congress if necessary.

Second Continental Congress. The British government ignored the Congress, and fighting broke out between Massachusetts farmers and British troops at Lexington and Concord in April 1775. The Second Continental Congress met in Philadelphia on May 10, 1775. New delegates of note were Benjamin Franklin, Thomas Jefferson, and John Hancock. The Congress took on many governmental duties, uniting the colonies for a fight. An army was organized, and George Washington was appointed commander in chief. On July 8, 1775, the Congress issued a declaration setting forth the need to take up arms and the reasons for doing so. On July 10, it made a final, futile appeal to the king in an effort to right matters without additional fighting.

With the outbreak of war, the Second Continental Congress encouraged the colonies to adopt new republican governments. On July 4, 1776, the Congress approved the Declaration of Independence. Then it drew up an outline for a permanent union of states that resulted in the Articles of Confederation, the first federal constitution of the United States. The second Congress operated under great difficulties because it depended on the states to carry out many of its decisions. On March 1, 1781, Maryland became the last of the states to ratify the Articles of Confederation. After ratification, the Congress was known as the *Congress of the Confederation,* but many people still called it the Continental Congress.

In addition to Peyton Randolph, the presidents of the Congress were Henry Middleton, John Hancock, Henry Laurens, John Jay, Samuel Huntington, Thomas McKean, John Hanson, Elias Boudinot, Thomas Mifflin, Richard Henry Lee, Nathaniel Gorham, Arthur St. Clair, and Cyrus Griffin. Jack N. Rakove

See also **Articles of Confederation; Congress of the Confederation; Continental Association; Declaration of Independence; Randolph, Peyton.**

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Continental divide is the term used to designate the line of elevated land that separates areas drained to opposite sides of a continent. In North America it is also called the *Great Divide,* and separates westward-flowing and eastward-flowing waters. In South America, the continental divide follows the western portion of the Andes Mountains. In Europe, the divide separates streams flowing to the Atlantic and Arctic oceans on the north and to the Mediterranean and Black seas on the south. In Asia, the divide separates drainage into the Arctic and Pacific oceans on the north and east from drainage into the Indian Ocean on the south. The African divide separates drainage into the Atlantic Ocean from drainage into the Indian Ocean. See also **Divide** (diagram); **Great Divide.** Frederick A. Cook

Continental drift. See **Plate tectonics.**

Continental shelf. See **Ocean** (The land at the bottom of the sea).

Continental System was France's attempt to choke off the United Kingdom's trade with the rest of Europe in the early 1800's. Emperor Napoleon I adopted it to destroy the United Kingdom financially. He began the system with his Berlin Decree of Nov. 21, 1806, declaring the United Kingdom in a state of blockade. His Milan

Decree of 1807 extended the blockade to neutral ships that stopped in the United Kingdom. Between 1808 and 1814, Napoleon tried to enforce the system by fighting the Peninsular War in Spain and Portugal and by invading Russia. The efforts failed and helped cause Napoleon's final defeat in 1815. Eric A. Arnold, Jr.

See also **Napoleon I** (Fall from power).

Continuing education. See **Adult education.**

Contour map. See **Map** (picture: Types of maps).

Contraband, *KAHN truh band,* in commerce, means *trade forbidden by law.* The word *contraband* most often refers to goods useful in war, such as arms or ammunition. The warships of a country at war may search for, seize, and destroy contraband goods that are being shipped to its enemy in neutral ships. In modern total warfare, almost anything is "useful for military purposes" and may be declared contraband. During World War I (1914-1918), the United Kingdom declared cotton to be contraband, because Germany used it to manufacture explosives. During World War II (1939-1945), Germany and the United Kingdom published contraband lists of many items. See also **Blockade.** Edwin B. Firmage

Contraception. See **Birth control.**

Contract is an agreement between two or more parties that is enforceable by law. A contract consists of voluntary promises to do or not do certain things. Promises in a contract are legal obligations. In the United States, Canada, and other countries that encourage private enterprise, much business activity depends on contracts. Contracts include promises to deliver or pay for goods, to perform or pay for labor or services, and to buy or rent land or other property.

In general, people or companies may include in their contracts any promises or terms they think fit. However, certain contracts are unenforceable. For example, the courts would not enforce an agreement to bribe a public official. They also may not require parties to obey a contract if one of the parties has clearly taken unfair advantage of another. The courts do not enforce contract obligations undertaken by minors or people who are mentally incompetent.

A majority of contracts are formed by an offer that is followed by an acceptance of the offer. In the majority of cases, the offer and acceptance may be communicated either orally or in writing. However, the law requires that some contracts be put in writing. These contracts include agreements to sell real estate and agreements that are to be performed over an extended period. Such contracts must name all the contracting parties, specify the price and all important terms, and be signed by any party who is to be legally obligated to perform the contract. Some businesses and individuals use *electronic signatures,* transmitted by computers, to complete contracts over the Internet.

Most contracts are enforceable only if each party gets *consideration* (something of value) from the agreement. Consideration can be money, property, a promise, or some right. For example, when an owner sells his or her house, the promised home is the consideration for the buyer. The seller's consideration is the money the buyer promises to pay for the house. Promises that do not involve consideration generally do not create a contract. The promise of the owner to give the house to a friend for nothing cannot be enforced as a contract.

Before a contract is formed, the parties usually discuss or negotiate its terms. If the parties intend to draw up a written contract, they may shake hands on a general deal before all the specific terms have been defined. In some cases, legal obligations are created by the handshake or by other actions performed prior to the signing of a formal document.

After the contract has been formed, the parties may continue to negotiate the details of how it should be carried out, especially if the contract is complex. In many such cases, the parties prefer to work out disagreements on their own rather than ask a court to resolve them. In these cases, the contract may serve only as general guidelines governing the future relationship between the parties.

A contract is said to be *discharged* when the obligations in the agreement have been fulfilled. If either party violates the terms of the contract, a *breach of contract* occurs. A court may award money damages to the other party, or order the breaching party to perform properly. James L. Winokur

See also **Bond; Lease.**

Contract bridge. See **Bridge** (card game).

Contractor. See **Building trade.**

Contrail, *KAHN trayl,* is a thin line of cloud that forms behind aircraft at high altitudes. Contrails consist of tiny water droplets or ice crystals. They form when water vapor in the air *condenses* (becomes liquid) or freezes.



Cameramann International, Ltd. from Marilyn Gartman

Contrails form behind aircraft at high altitudes. Ice crystals from a contrail may cause precipitation to fall from clouds.

Contrails are also called *condensation trails, exhaust trails,* or *vapor trails.*

A contrail may form in two ways. (1) The exhaust from an aircraft engine contains water vapor. This vapor may condense when it mixes with cold air around the plane. Contrails last longest in very cold air, and so they are rarely seen when an aircraft takes off or lands. This way is by far the most common. (2) When a plane moves through the air, water vapor may condense in thin clouds over the wings and behind the wing tips and the tips of the propellers. The condensation occurs because the air temperature drops as the pressure drops.

Contrails may have some effect on the weather. For example, ice crystals from a contrail may cause rain or snow to fall from certain clouds. The crystals act like the chemicals used to "seed" clouds in rainmaking operations. See **Rainmaking.** Margaret A. LeMone

Contusion. See Bruise.
Convection. See Heat (How heat travels); Cloud (How clouds form).
Convector. See Heating (Steam and hot-water heating systems; diagrams).
Convent is a religious community, usually of women, who have taken religious vows and live under religious rule. The term is commonly applied to an order or society of female Christian nuns, and especially to the building in which they live. The head of a convent is usually called a *mother superior,* but may have a different title, such as *abbess* or *prioress.*

The word *convent* comes from the Latin word *conventus,* which means *assembly* or *gathering.* Originally, the word meant any religious house. During the Middle Ages, the Franciscan order used the word to distinguish its new form of life from the older abbey or monastery forms.

In a *cloistered* convent, the sisters and novices are isolated from the outside world. In their cloistered life, they seek their own salvation and that of others through a program of worship, prayer, and contemplation. The Carmelites and the Poor Clares are contemplative orders. *Uncloistered* convents include orders, societies, and institutes that conduct schools, maintain hospitals, and provide other types of social services. Examples are the Little Sisters of the Poor and the Daughters of Charity. To some degree, almost all orders seek to combine the two ways of life.

Buddhist and Taoist nuns also live in convents. They devote themselves to contemplative lives, but they are not as fully isolated from society as the Christian contemplative orders. Anne E. Carr

See also **Cloister; Monasticism; Nun; Religious life.**
Convention. See **Political convention.**
Convertibility, *kuhn VUR tuh BIHL uh tee,* is the absence of restrictions on exchanging the currency of one nation for that of another. Convertibility plays an important role in international trade. For example, an importer from nation A buying goods from nation B must find a way to pay for them. This is much easier if the two currencies are convertible, because all the importer needs to do is go to the bank and purchase a check for an equivalent amount in B's currency. Otherwise, the importer may not be able to buy B's goods if B restricts the availability of its currency.

Convertibility exists for the world's major currencies. However, the currencies of China and other Communist nations and of some less developed countries are inconvertible. See also **Exchange rate; Money** (International finance). Robert M. Stern

Conveyor belt is a device that *conveys* (carries) large quantities of material from place to place. It consists of an endless belt that is looped over two pulleys. One of the pulleys is called the *drive pulley,* and supplies the power that keeps the belt moving. Most conveyor belts are powered by an electric motor.

The belt travels over a series of rollers that reduce friction and support the belt. The material moves along the belt at a moderate speed in a straight line. A conveyor belt can carry material at a much steeper grade, or slant, than can a truck or a railroad train. The steepness of the grade is limited only by the slant at which the material will slide down the belt. Conveyor belts, such as those used in mines and quarries, may be 1 mile (1.6 kilometers) or more in length.

Types of conveyor belts. The belt of a conveyor may be flat and wide, and the materials simply placed on the belt to be carried away. But for moving bulk material, such as sugar or salt, the belt forms a trough so the material can be moved without spilling. Other conveyor belts consist of chains that have buckets hanging from the chain. Some chain belts have either hooks or scoops that pick up the material and carry it from one place to another.

Many times, a conveyor belt makes up only a part of a much larger conveyor system. If the conveyor system must change directions or turn a corner, the material is dropped from one belt to another belt that moves in the desired direction. In such a system, each belt is called a *flight.* Different flights are needed for each change of direction required.

Uses. Conveyor belts play an important part in mass production. Automobiles, for example, move along the assembly line on a conveyor system (see **Assembly line**). Workers stand in one place, and the materials to be worked on move past them.

In airports, conveyor belts carry luggage from the ticket counter to the baggage room. Many buildings now use moving sidewalks, which consist of a ramplike conveyor belt with handrails. An escalator is a conveyor belt designed to form stairs as it moves around as an endless belt. In meat-packing plants, conveyor belts carry the carcasses of the animals from one station to another to be processed.

Conveyor belts are widely used to load and unload ships, trucks, and railroad cars. One such system moves over 6,000 tons (5,400 metric tons) of coal an hour in a steady stream from railroad cars to the belt. The belt carries the coal to a loading tower that distributes the coal to the various parts of a ship. Mines transport their ores

Conveyor belt



Eric Carle, Shostal

A moving sidewalk is actually a flat conveyor belt.



Bob Peterson, West Stock

A conveyor belt carries cheese along an assembly line.

to ships or factories in much the same way.

Many industries use special types of conveyor belts to make their products. Large bakeries, for example, use conveyor belts to speed up the baking of bread. The mixed dough is placed in pans and put on an endless belt that passes through a walled oven over 100 feet (30 meters) long. It takes about 30 minutes to carry the pans through the oven. The continuous movement of a number of these belts allows large bakeries to bake over 30,000 loaves of bread an hour. Marvin F. DeVries

See also **Escalator**.

Convulsions are involuntary contractions of groups of muscles often accompanied by loss of consciousness. Convulsions originate in the brain and may indicate damage to brain tissue, such as might result from injury, infections, or tumors. Convulsions may also occur during many illnesses. In young children, convulsions often accompany fever. Multiple convulsions of unknown causes occur in epilepsy.

Convulsions vary in form and degree. Sometimes the victim's whole body becomes rigid. At other times, the body may twist and turn, and the muscles of the face, legs, and arms may twitch. In some types of epilepsy, only one limb, or even just a part of it, may be involved.

A person who has convulsions should be placed on his or her side to prevent choking if vomiting occurs. If the teeth are not tightly clenched, a handkerchief or another soft object may be placed between them to prevent injury to the tongue. A doctor should always be called for a patient with convulsions. Treatment depends on the cause. Marianne Schuelein

See also **Anticonvulsant; Epilepsy; First aid** (Convulsion and epileptic seizure).

Cony. See **Hyrax; Pika.**

Cook, Frederick Albert (1865-1940), an American explorer, claimed he discovered the North Pole in April 1908. His story was questioned when Robert E. Peary returned from a polar expedition in September 1909. Danish scientists found that Cook could not prove his claims. But he had made a difficult expedition through the Canadian Arctic islands in 1908 and 1909. Cook's claim that he reached the summit of Mount McKinley, Alaska, also was disputed. Cook was born on June 10, 1865, in Callicoon Depot, New York. William Barr

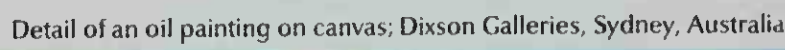
Cook, James (1728-1779), a British naval captain and navigator, was one of the world's greatest explorers. He commanded three voyages to the Pacific Ocean that greatly increased knowledge of the world's geography. Cook had an outstanding ability to accurately determine where newly encountered lands should be placed on maps. He was able to prevent the high death tolls from disease that had long been common on sea voyages. He also was known for his peaceful relations with the peoples he came across on his expeditions.

A number of the officers Cook trained became explorers themselves. They copied him in the care of their crews, the accuracy of their mapping, and their respectful dealings with the peoples they met. Cook's example was thus perhaps as important as his own achievements.

Early life. Cook was born in Marton, England, near Middlesbrough, on Oct. 27, 1728. He began working as an apprentice for a shipowner in his late teens and quickly grew to be an excellent sailor. In 1755, Cook joined the British navy. The Seven Years' War between Britain (now the United Kingdom) and France broke out the following year. During the war, Cook served in Canada, where he learned surveying, mathematics, and astronomy. After the war ended in 1763, he was sent to survey part of Canada's eastern coast.

First Pacific voyage. Cook's work was so highly regarded that the navy chose him to lead an important expedition in 1768. His ship, the *Endeavour,* sailed to the South Pacific island of Tahiti. From there, Cook's crew watched the planet Venus as it moved across the face of the sun. Scientists wanted to observe this movement from several places on Earth, believing that the distance from Earth to the sun could then be calculated. Cook explored Tahiti and nearby islands for three months, collecting information about the Tahitians and their culture.

Cook then sailed south in search of a large continent that some scientists thought must exist in the South Pacific. But he did not find it. He went to New Zealand,


Detail of an oil painting on canvas; Dixson Galleries, Sydney, Australia




Detail of an oil portrait by John Webber. National Portrait Gallery, London

James Cook, a British navigator, explored many islands in the Pacific Ocean. He landed on the Hawaiian Islands in 1778 and was killed by the Hawaiians in 1779. The British artist John Webber painted *Death of Cook,* shown here, in the late 1700's.

charted its coastline, and encountered the Maori people there. He then continued west toward what is now called Australia and mapped that continent's east coast (see **Australia** [History; map]).

One of Cook's great successes was preventing major outbreaks of *scurvy* on his voyages. Scurvy is a disease caused by a lack of vitamin C. It can be prevented by eating foods such as fresh fruits and vegetables. Because Cook fed his sailors appropriately, no one died from scurvy during the three-year voyage of the *Endeavour.*

Second Pacific voyage. In 1772, Cook was sent on another voyage, this time with two ships, the *Resolution* and the *Adventure.* The purposes of this voyage were to search further for the suspected South Pacific continent and to test a new navigational instrument called a *chronometer.*

Cook sailed far to the south and became the first navigator to cross the Antarctic Circle. The sight of huge icebergs convinced him that a polar continent must exist. But ice and severe weather prevented him from getting close enough to see it. See **Antarctica** (Early exploration).

During the voyage, Cook visited New Zealand three times. He also located and mapped islands that earlier explorers had failed to place accurately on maps. He visited Easter Island, the Marquesas Islands, the Tuamotu Islands, New Caledonia, Tonga, New Hebrides (now Vanuatu), the Cook Islands, and Tahiti again.

Final voyage. In 1776, the British government decided that Cook should lead a third voyage. He was given two ships, the *Resolution* and the *Discovery.* The purpose of this voyage was to find a *Northwest Passage*—a northern sea route between the Pacific and the Atlantic oceans. Explorers had been looking for such a passage for more than 200 years.

On the way to the North Pacific, Cook revisited New Zealand, Tonga, and Tahiti. He and his crew also became the first Europeans definitely known to have visited Hawaii. In 1778, Cook explored the northwest coast of North America and sailed into the Arctic Sea.

Cook returned to Hawaii for the winter. On Feb. 14, 1779, he was killed in a dispute between his men and the Hawaiians. Cook's ships tried to continue the voyage, but little more was accomplished. The ships returned to England in 1780. I. C. Campbell

See also **British Columbia** (European contact); **Hawaii** (Visitor's guide; European exploration).

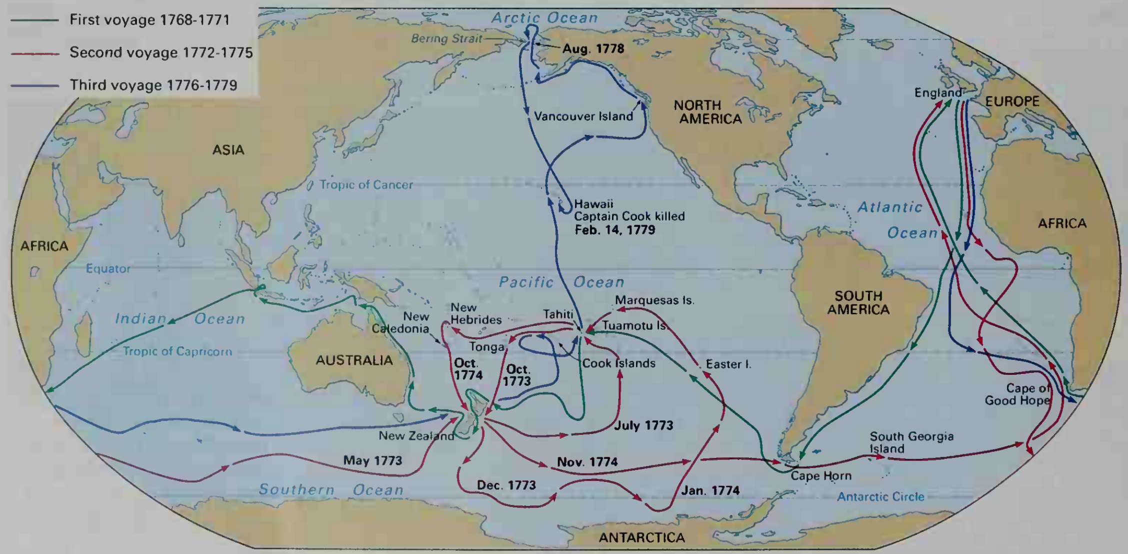
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Cook Islands lie in the South Pacific Ocean, about 1,800 miles (2,900 kilometers) northeast of New Zealand. For location, see **Pacific Islands** (map). The 15 islands of the Cook group are spread out over 850,000 square miles (2.2 million square kilometers) of ocean. They have a total land area of 91 square miles (236 square kilometers) and a total coastline of 90 miles (145 kilometers). The main islands include Rarotonga, Mangaia, Atiu, Aitutaki, and Mauke. The capital, Avarua, is on the northern shore of Rarotonga. The southern islands have fertile soil and a mild climate. Their chief exports include copra, fruits, and tomatoes. Most of the 20,000 people are Polynesians.

In 1773, Captain James Cook became the first known European to reach the islands. The United Kingdom took control of the islands in 1888 and gave administrative control to New Zealand in 1891. A new constitution gave the islanders control of their internal affairs in 1965. Today, the islands have an arrangement with New Zealand called *free association.* Under free association, the islands are self-governing, the people are citizens of New Zealand, and New Zealand offers the islands military support for defense. W. B. Johnston



James Cook's explorations included three voyages to the Pacific Ocean. He reached New Zealand in 1769 and sailed to Australia in 1770. From 1772 to 1775, Cook sailed to New Zealand again and crossed the Antarctic Circle. In 1778, he reached Hawaii.

Cooke, Jay (1821-1905), an American financier, was the chief financial agent for the United States during the American Civil War (1861-1865). He sold war loans, which totaled well over $1 billion. Cooke was born in Sandusky, Ohio. He worked his way up from a clerkship in a Philadelphia bank to the establishment of his own banking firm in 1861. In 1873, the failure of his company helped bring on a general financial panic. In 1878 and 1879, Cooke made another fortune in Western silver mines. James M. McPherson

Cooke, Terence James Cardinal (1921-1983), archbishop of New York, was appointed a cardinal of the Roman Catholic Church in 1969 by Pope Paul VI. Cooke, at 48, was the youngest American ever to become a cardinal. Cardinal Cooke was born and raised in New York City. He was ordained in 1945 after graduating from St. Joseph's Seminary in Yonkers, New York. He earned a master's degree in social work at the Catholic University of America in Washington, D.C., and taught at Fordham University in New York City. He became archbishop of New York in 1968, and guided the archdiocese during the transition years after Vatican Council II (1962-1965). Robert P. Imbelli

Cooking is the preparation of food for eating by applying heat. Cooking makes food more appetizing and easier to digest. It also kills harmful bacteria that could otherwise cause illness. Many people enjoy cooking. Skillful cooks take great care in preparing delicious, attractive, and nutritious meals. Some people use the term *cooking* to refer to preparation of all foods, not just those that are heated.

Most people can prepare lettuce salad or other foods without written directions. But many foods, including cakes and sauces, turn out well consistently if prepared according to a recipe. Many cookbooks with a wide variety of recipes are available. Recipes also appear on food packages and in many magazines and newspapers.

This article discusses basic principles of planning meals and preparing food. Some cookbooks give general tips on both topics in addition to providing recipes. A beginner should first try simple recipes and meals and then go on to more difficult ones.

Planning meals

Meal planning involves several factors. The food should be nutritious and appealing, and its cost should be within a family's budget. A cook also must consider the time required to prepare certain meals.

Planning nutritious meals requires a basic knowledge of the body's nutritional requirements and the nutrients in different foods. Nutritionists divide foods into basic groups and recommend a certain number of daily servings from each group. The Nutrition article describes these food groups and lists the recommended number of servings. Meals planned according to these guidelines provide the nutrients a person needs without adding extra calories or dietary fat.

Planning appealing meals. An appealing meal includes foods that have contrasting colors, shapes, textures, flavors, and temperatures. The selection of vegetables and fruits can be especially important in adding color to a meal. For example, a meal of sliced turkey, cauliflower, mashed potatoes, white bread, and milk would look unappetizing. A green vegetable and an orange one, instead of cauliflower and potatoes, would make the meal more colorful and appealing. Cutting carrots, beets, and other vegetables into contrasting shapes can also help create variety. The textures of solid foods range from soft to firm, and a meal should include foods that vary in chewiness. Most meals also should include at least one hot food and one cold dish. In addition, a person should serve foods that differ in flavor.

Foods called *garnishes* can make a dish more attractive. They usually are arranged around the food after it has been cooked. Common garnishes include parsley sprigs, tomato slices, and lemon wedges.

Planning economical meals. There are many ways to save money on food and still provide nutritious, tasty meals. Shoppers can watch for reduced prices on food, buy fresh produce only when it is in season, and select less expensive brands of food. In many cases, lower-priced foods can be substituted for higher-priced ones. For example, nonfat milk and nonfat dry milk solids are less expensive than whole milk. Some kinds of vegetables, fish, poultry, and red meat cost less than others. A person also can serve smaller portions of meat and larger portions of less expensive foods such as breads, cereals, and *legumes,* such as peas and beans.

Planning time-saving meals. Because of a lack of time, a person sometimes must plan meals that do not require much preparation. *Convenience foods,* which include canned foods, frozen dinners, and precooked

Some rules for safe food preparation

Wash your hands with soap and water for 20 seconds before beginning food preparation and after handling raw meat, poultry, seafood, or eggs.

Prevent juices from raw meat, poultry, or seafood from touching cooked foods or foods that will be eaten raw, such as fruits or salad ingredients.

Wash counters, equipment, utensils, and cutting boards with soap and water immediately after use.

Thaw frozen foods in the refrigerator, never on the counter. Or, thaw the food in a microwave oven, then cook it immediately.

Marinate foods in the refrigerator, never on the counter. Discard the marinade after use because it contains raw juices. If you want to use the marinade as a dip or sauce, reserve a portion before you add the raw food.

Always cook foods thoroughly. If harmful bacteria are present, only thorough cooking will destroy them. Freezing or rinsing foods in cold water is not sufficient to destroy bacteria.

Use a meat thermometer to determine if your meat or poultry has reached a safe internal temperature. Check the product in several spots to assure that a safe temperature has been reached. To be safe, beef and pork must reach 160 °F (71 °C); whole poultry and poultry thighs, 180 °F (82 °C); and poultry breasts, 170 °F (77 °C).

Avoid interrupted cooking. Never refrigerate partially cooked meat or poultry dishes to later finish cooking them on a grill or in the oven. Meat and poultry products must be cooked thoroughly the first time, and then they may be refrigerated and safely reheated later.

When serving, keep hot foods hot—140 °F (60 °C) or higher—and cold foods cold—41 °F (5 °C) or lower.

Never leave foods, raw or cooked, at room temperature for longer than two hours.

Source: United States Department of Agriculture





WORLD BOOK photos

Cooking is a basic household activity that can also be an enjoyable pastime. Skillful cooks take great care and pleasure in planning and preparing good meals, *left.* They serve foods that are attractive, tasty, and nutritious. An appealing, nourishing meal, *right,* includes a variety of foods that have contrasting colors, textures, flavors, and temperatures.

meats, require little or no preparation. However, many convenience foods cost more than the basic ingredients that would be used to prepare the same dishes. Time can also be saved by serving uncooked fruits and vegetables. Some foods can be prepared and frozen ahead of time and then thawed and heated before being served.

Methods of cooking

The basic methods of cooking include (1) baking, (2) roasting, (3) broiling and grilling, (4) frying, (5) boiling, (6) simmering, and (7) steaming. Salt, pepper, and other seasonings may be added to improve flavor.

Baking. Food is baked by cooking it in an oven. In most cases, the oven temperature ranges from 300 to 450 °F (149 to 232 °C). The word *baking* usually refers to the cooking of foods made from a batter or dough. Such foods include breads, cakes, cookies, and pastries. However, casseroles, a few vegetables and fruits, and some cuts of meats can also be baked.

Roasting is cooking food uncovered in hot air. The term usually refers to the cooking of meat. For example, a turkey or a leg of lamb is roasted. In roasting, the meat is usually placed on a rack in a shallow pan and cooked uncovered in an oven. The temperature usually ranges from 300 to 350 °F (149 to 177 °C).

Broiling and grilling are cooking by the application of direct heat. In broiling, the food lies directly under a continuous heat source. Meat can be broiled by placing it on a rack in a shallow broiler pan. The surface of the meat lies 3 to 5 inches (8 to 13 centimeters) under the flames in a gas range broiler or below the broiler heating unit in an electric oven. Leave the door open slightly when broiling in an electric oven to prevent the air in the oven from becoming too hot. In grilling, the food lies directly over the heat source. Cooks sometimes grill sandwiches in a skillet on the stove.

In barbecuing, highly seasoned meat is grilled over hot coals. In *panbroiling,* the meat cooks in a skillet over a burner. The fat that melts from the meat is poured out of the pan as it accumulates.

Frying is the cooking of food in fat, such as butter or vegetable oil. Frying adds fat and calories to food because the food absorbs some of the fat in the pan.

There are three main methods of frying: (1) deep-frying, (2) pan frying, and (3) stir-frying. In deep-frying, a large amount of fat is heated to about 350 °F (177 °C) in a heavy saucepan or an electric appliance called a *deep-fryer.* The hot fat completely covers the food. Deep-frying is a popular way of cooking chicken, French fried potatoes, and shrimp. In pan frying, also called *sautéing,* the food cooks in a small amount of fat, usually in a skillet. Chicken, eggs, fish, and red meat are often pan fried.

In stir-frying, meat or vegetables cook in a skillet or in a *wok,* a large, thin metal pan with a round bottom. The food is cut into small pieces and cooked in an extremely small amount of fat. The cook fries the food at a high temperature for only a few minutes and stirs it constantly with a tossing motion.

Boiling is cooking food in boiling water, which has a temperature of about 212° F (100° C). In boiling, air bubbles rise to the surface of the water and break. Potatoes and other vegetables are often boiled in a saucepan over a burner.

Simmering is cooking food in water that is just below the boiling point. Such foods as eggs and meats should be simmered rather than boiled. Cooks often use covered saucepans to simmer foods. *Slow cookers* are electric appliances that simmer foods at low temperatures for 4 to 12 hours. A cook puts the food and some water in a slow cooker and sets the temperature. Health experts recommend caution when using a slow cooker for meat and other foods prone to bacterial growth at warm temperatures. Use sanitary methods in prepar-

ing the food and keep it refrigerated until just before cooking.

Steaming is cooking food in steam. It is used mostly to cook vegetables. To steam vegetables, place them on a rack or perforated pan in a saucepan and add water to the saucepan. The water collects below the rack or perforated pan, and the vegetables remain above—and out of—the liquid. Cover the saucepan and heat it on a burner until the water boils and forms steam, which surrounds and cooks the vegetables. Steaming takes longer than boiling. However, steamed vegetables retain better color and flavor than boiled vegetables do. They also have more nutrients because certain vitamins, including vitamin C, dissolve easily in water and may be removed by boiling.

Other methods. Some foods that require a long time to cook, such as stews and dried beans, may be prepared more quickly in a *pressure saucepan.* This utensil cooks foods at high temperatures by means of steam under pressure. Pressure saucepans are also called *pressure cookers.*

Another fast method of cooking uses *microwaves* (short radio waves). Microwave ovens heat small amounts of foods much faster than gas or electric ovens or cooktops do. Microwave ovens are especially useful for thawing frozen foods and heating soups, vegetables, and leftovers.

Terms used in cooking

Baste is to moisten a food while cooking it, usually by brushing or pouring melted butter, cooked meat drippings, or another liquid over it.

Beat is to mix one or more ingredients vigorously with a spoon, an eggbeater, or an electric mixer.

Blanch is to precook or preheat a food in boiling water or steam for a short time.

Braise is to cook meat slowly in a small amount of liquid in a tightly covered pan.

Bread is to coat a food with breadcrumbs, cracker crumbs, or crushed breakfast cereal before cooking.

Brown is to cook a food quickly, often in a small amount of fat, until the food turns golden-brown.

Cream is to mix one or more ingredients with a spoon or an electric mixer until the mixture becomes soft and creamy.

Dice is to cut into small cubes.

Fold is to add an ingredient to a mixture by gently turning one part over another with strokes of a flexible spatula or scraper.

Glaze is to give a shiny appearance to food by coating it with a sauce, syrup, or another liquid.

Grate is to shred a food by rubbing it against a grater.

Grease is to lightly coat the inside of a pan with butter, shortening, or other fat.

Marinate is to soak a food in a seasoned liquid to enhance its flavor and texture.

Pare is to cut the peel or outer covering off a food.

Poach is to simmer a food in water or another liquid.

Purée is to form a paste from a food, usually by cooking it and then pressing it through a sieve or whipping it in a blender.

Sauté is to fry a food in a small amount of fat until it turns golden-brown.

Skim is to remove the top layer from a liquid food, such as removing fat from soup.

Whip is to beat food rapidly to add air and increase the food's volume.

History

Prehistoric people broiled and roasted meat over small open fires. Boiling probably came into use later than other methods of cooking because it requires a container to hold the water. People boiled food in leather, wood baskets, and shells before pottery and metal containers were developed.

The ancient Egyptians cooked their food mostly over open fires. They also baked bread in clay ovens heated with burning wood or charcoal.

In ancient Rome, people cooked on raised brick hearths. They set large kettles on iron tripods over the fire. In addition, the Romans baked bread in tile ovens.

During the Middle Ages, a period that lasted from the A.D. 400's to the 1500's, people in Europe used fireplaces for cooking. They heated food in a kettle and broiled or roasted meat on a slowly turning rod called a *spit.* Only the wealthy had ovens in their homes.

In the 1600's and 1700's, most people in North America cooked their food in kettles or on spits in their fireplace, as Europeans did. Many fireplaces had built-in ovens. Iron cookstoves, most of which burned wood, became popular in the early 1800's. The first practical coal-burning stove, called a *baseburner,* was patented in 1833. Gas ranges began to be used in cities during the 1860's.

Electric ranges became popular in the 1930's, and microwave ovens were introduced in the 1950's. As a result of improvements in these and other appliances, cooking today is much easier and faster than ever.

Helen C. Brittin

Related articles in *World Book* include:

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Food
Food, Frozen
Food poisoning
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Meat (How meat is cooked; diagram: How to carve meat)
Microwave oven
Nutrition (Store and cook foods properly)
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Pioneer life in America (Food)
Range
Restaurant
Spice
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Vegetable
Western frontier life in America (Food)

Additional resources

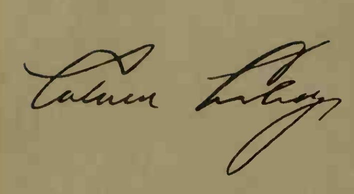
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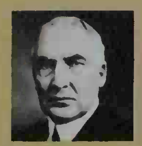
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Cooley's anemia. See Thalassemia.



30th President of the United States 1923-1929



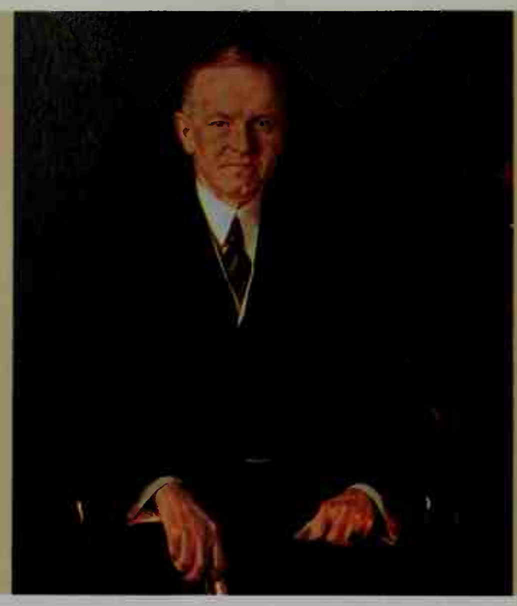
Harding
29th President
1921-1923
Republican



Coolidge
30th President
1923-1929
Republican



Hoover
31st President
1929-1933
Republican





Charles G. Dawes
Vice President
1925-1929

Keystone

Coolidge, Calvin (1872-1933), was a shy, silent New England Republican who led the United States during the boisterous Jazz Age of the 1920's. He was the sixth Vice President to become President upon the death of a chief executive. Coolidge was vacationing on his father's farm in Vermont when President Warren G. Harding died in 1923. The elder Coolidge, a notary public, administered the oath of office in the dining room. Never before had this ceremony been performed by such a minor official or by a President's father.

In 1924, Coolidge was elected to a full four-year term. He enjoyed great popularity and probably could have been reelected. But he decided to retire. His terse announcement became his most famous statement: "I do not choose to run for President in 1928." Herbert Hoover succeeded him.

Americans respected the views of the closemouthed Coolidge. His reputation for wisdom was based on his common sense and dry wit. He issued few unnecessary public statements and rarely wasted a word.

Coolidge, who had risen to fame as governor of Massachusetts, served as President during the Roaring 20's. Prosperity stimulated carefree behavior and a craving for entertainment. The nation's "flaming youth," featured in the novels of F. Scott Fitzgerald, set the pace. Sports figures became national heroes as Babe Ruth hit 60 home runs in one season and Gene Tunney defeated Jack Dempsey in the famous "long-count" bout. Charles A. Lindbergh made the first solo flight across the Atlantic Ocean. Motion pictures began to talk, with Al Jolson starring in *The Jazz Singer.* George Gershwin brought jazz into the concert hall with his *Rhapsody in Blue.* Americans defied Prohibition, and Al Capone and other gangsters grew rich by bootlegging liquor. A popular song summed up the spirit of the whole era: "Ain't We Got Fun?"

The solemn, frugal Coolidge seemed to be a misfit from another era. But people voted for him even if they did not imitate his conduct. They cherished him for having the virtues of their pioneer ancestors.

Early life

Childhood. Calvin Coolidge was born on July 4, 1872, in Plymouth Notch, a village near Woodstock in central Vermont. He was named for his father, John Calvin Coolidge, but his parents called him *Calvin,* or *Cal.* He dropped the name *John* after leaving college.

Calvin's parents had been childhood playmates in Plymouth Notch. His father was descended from an English family that came to America about 1630. When Calvin was 4 and his sister, Abigail, was 1, his father bought a small farm across the road from the family store. Cal helped with the farm chores and studied in a small stone schoolhouse nearby.

The elder Coolidge served three terms in the Vermont House of Representatives and one term in the state Senate, and held many local public offices. He passed his political shrewdness on to his son.

Education. Coolidge's mother, Victoria Josephine Moor Coolidge, died when he was 12 years old. The next year he entered Black River Academy at nearby Ludlow. He graduated in 1890. His sister, who also attended the school, had died of an intestinal ailment a short time before. He took a short course at St. Johnsbury Academy, and entered Amherst College in 1891.

As a college student, Coolidge showed great interest in political campaigns. He earned only fair grades during his first two years, but graduated *cum laude* in 1895.

Coolidge then read law with the firm of Hammond and Field in Northampton, Mass. He passed the Massachusetts bar examination in 1897, and about seven months later opened his own office in Northampton.

Political and public activities

Entry into politics. Coolidge became an active worker for the Republican Party in 1896. He was elected





The Roaring Twenties were an era of fads and heroes. The women above are doing the Charleston, a dance craze of the period. The American aviator Charles A. Lindbergh, *left,* became a world hero in 1927, when he made the first solo flight across the Atlantic Ocean. This picture was taken just before Lindbergh took off on his flight from New York City to Paris.

The world of President Coolidge

The Immigration Act of 1924 limited the number of immigrants admitted to the United States. It also established a quota system to prevent major changes in the racial or ethnic makeup of the nation's population.
The Golden Age of radio broadcasting began about 1925. Nationwide audiences listened to such programs as "The A & P Gypsies" and "The Voice of Firestone."
The Scopes Trial, in 1925, upheld the right of a state to ban the teaching of evolution in public schools.
The first successful liquid-fuel rocket was launched in 1926 by Robert H. Goddard, the American rocket pioneer.
Jazz was the leading form of popular music. Jazz musicians who became stars during the mid-1920's included Louis Armstrong, Duke Ellington, and Fletcher Henderson.
Babe Ruth of the New York Yankees hit 60 home runs during the 1927 baseball season, a record that stood until 1961.
The Kellogg-Briand Peace Pact was signed by 15 nations in 1928 and eventually by nearly all the nations of the world. The signers of the treaty, also called the Pact of Paris, agreed not to use war to solve international problems.
***Penicillium* mold,** which produces the antibiotic drug *penicillin,* was discovered in 1928 by Sir Alexander Fleming, a British bacteriologist.

Brown Bros.; Library of Congress

to the Northampton city council in 1898, and became city solicitor in 1900. He won reelection in 1901, but lost in 1902.

In 1904, Coolidge met his future wife, Grace Anna Goodhue (Jan. 3, 1879-July 8, 1957), a teacher at the Clarke School for the Deaf in Northampton. She was cheerful, talkative, and fun-loving—just the opposite of the quiet Coolidge. Shortly after their marriage on Oct. 4, 1905, he arrived home from his office with a bag containing 52 pairs of socks, all with holes. When his bride asked if he had married her to darn his socks, Coolidge, with characteristic bluntness, replied: "No, but I find it mighty handy." The Coolidges had two sons, John (1906-2000), who became a business executive, and Calvin, Jr. (1908-1924).

Coolidge was elected to the Massachusetts house of representatives in 1906, and was reelected the next year. He won election as mayor of Northampton in 1909, and was returned to office in 1910. From 1912 to 1915 Coolidge served in the state senate, with two terms as president of that body. He was elected lieutenant governor in 1915, and twice won reelection. He was elected governor in 1918.

As governor, Coolidge became nationally famous during the Boston police strike of 1919. In defiance of police department rules, a group of Boston police officers had obtained a union charter from the American Federation of Labor. Police Commissioner Edwin U. Curtis suspended 19 of the union's leaders, and the next day almost three-fourths of Boston's more than 1,500 police officers went on strike.

Bands of hoodlums roamed Boston for two nights, smashing windows and looting stores. Coolidge mobilized the state guard, and order was restored. When Curtis fired the 19 suspended police officers, Samuel Gompers, president of the AFL, protested to Coolidge. In reply, Coolidge made his famous declaration: "There is no right to strike against the public safety by anybody, anywhere, any time."

Coolidge won reelection in 1919 by a record vote. In

Important dates in Coolidge's life

1872 (July 4) Born in Plymouth Notch, Vermont.
1905 (Oct. 4) Married Grace Anna Goodhue.
1906 Elected to Massachusetts House of Representatives.
1909 Elected mayor of Northampton, Massachusetts.
1911 Elected to Massachusetts Senate.
1915 Elected lieutenant governor of Massachusetts.
1918 Elected governor of Massachusetts.
1920 Elected Vice President.
1923 (Aug. 3) Sworn in as President.
1924 Elected to full term as President.
1933 (Jan. 5) Died in Northampton, Massachusetts.



Calvin Coolidge Memorial Foundation

Coolidge's birthplace was this house in Plymouth Notch, Vermont. Coolidge spent most of his childhood there.

1920, he received some votes for the presidential nomination at the Republican National Convention that chose Senator Warren G. Harding of Ohio. The delegates gave Coolidge the vice presidential nomination on the first ballot. Harding, friendly and easy-going, and Coolidge, silent and unsmiling, won an overwhelming victory over their Democratic opponents, Governor James M. Cox of Ohio and Assistant Secretary of the Navy Franklin D. Roosevelt.

Vice President. At Harding's invitation, Coolidge regularly attended meetings of the Cabinet. He was the first Vice President to do so.

Even in the social whirl of Washington, Coolidge remained unchanged. He rarely smiled, almost never laughed, and sat silently through official dinners. At one affair, a woman told him she had bet that she could get more than two words out of him. Replied Coolidge: "You lose."

Early on the morning of Aug. 3, 1923, while vacationing on his father's farm, Coolidge was awakened with the startling news of Harding's death. He dressed and knelt in prayer, then walked downstairs to the dining room. There, by the light of a kerosene lamp, his father administered the presidential oath at 2:45 a.m. After that, Coolidge went back to bed—and slept. Years afterward, when asked to recall his first thought upon becoming President, he replied: "I thought I could swing it."

Eighteen days later, Coolidge had a second oath of office administered by a justice of the Supreme Court of the District of Columbia. Attorney General Harry M. Daugherty had questioned the validity of the first oath, because Coolidge's father had authority to swear in only state officials of Vermont.

Coolidge's Administration (1923-1929)

Cabinet. Only three members of Harding's Cabinet remained in office throughout the Coolidge Administration. They were Secretary of the Treasury Andrew W. Mellon, Postmaster General Harry S. New, and Secretary of Labor James J. Davis. Herbert Hoover, secretary of commerce under Harding, served until he resigned in 1928 to run for President.

Corruption in government. Coolidge entered the White House just as the Teapot Dome and other scandals of the Harding Administration became public. Coolidge made no effort to shield the guilty, and his personal honesty was never questioned. In 1924, he forced the resignation of Attorney General Daugherty and other high officials who had been connected with the scandals. See **Harding, Warren Gamaliel** (Government scandals); **Teapot Dome**.

"Constructive economy." Coolidge continued Harding's policy of supporting American business at home and abroad. He favored a program of what he called "constructive economy," and declared that "the chief business of the American people is business." The government continued high tariffs on imports in an effort to help American manufacturers. Although Congress reduced income taxes, revenue from taxes increased and the administration reduced the national debt by about a billion dollars a year. Congress also restricted immigration beyond what it had done in 1921. Coolidge vetoed the World War I veteran's bonus bill, but Congress passed it over his veto.



Grace Coolidge, Coolidge's wife, was a teacher of the deaf before their marriage. She posed for this portrait by the American artist Howard Chandler Christy in 1924.

Coolidge's election

Place of nominating convention	Cleveland
Ballot on which nominated	1st
Democratic opponent	John W. Davis
Electoral vote*	382 (Coolidge) to 136 (Davis) and 13 (La Follette)
Popular vote	15,717,553 (Coolidge) to 8,386,169 (Davis)
Age at second inauguration	52

*For votes by states, see **Electoral College** (table).

Vice President and Cabinet

Vice President	* Charles G. Dawes
Secretary of state	* Charles Evans Hughes
	* Frank B. Kellogg (1925)
Secretary of the treasury	* Andrew W. Mellon
Secretary of war	John W. Weeks
	Dwight F. Davis (1925)
Attorney general	Harry M. Daugherty
	* Harlan F. Stone (1924)
	John G. Sargent (1925)
Postmaster general	Harry S. New
Secretary of the Navy	Edwin Denby
	Curtis D. Wilbur (1924)
Secretary of the interior	Hubert Work
	Roy O. West (1928)
Secretary of agriculture	Henry C. Wallace
	Howard M. Gore (1924)
	William M. Jardine (1925)
Secretary of commerce	* Herbert Hoover
	William F. Whiting (1928)
Secretary of labor	James J. Davis

*Has a separate biography in *World Book*.

A paradox of the Coolidge era was that the president stood for economy and a simple way of life, and yet enjoyed great popularity with a public that largely had thrown thrift to the winds. Some economists warned that this period of prosperity would end in a dreadful depression. But most Americans believed that good times had come to stay. Coolidge did not try to stop the speculation which contributed to the stock market crash of 1929 seven months after he left office.

Farmers did not share in the general prosperity. Farm prices had fallen, and the purchase of farm products by other nations had declined because of a worldwide surplus of agricultural products. Coolidge twice vetoed a bill to permit the government to buy surplus crops and sell them abroad. Coolidge also pocket-vetoed a bill that would have let the government operate the Muscle Shoals power facilities as an electric power project (see **Muscle Shoals; Veto**).

"Keep Cool with Coolidge." Coolidge had no important rivals for the Republican presidential nomination in 1924. After naming him on the first ballot, the party's national convention chose Charles G. Dawes, director of the Bureau of the Budget, for vice president. The Democrats nominated John W. Davis, former ambassador to the United Kingdom, for president, and Governor Charles W. Bryan of Nebraska for vice president. Dissatisfied members of both parties formed the Progressive Party. They nominated Senator Robert M. La Follette of Wisconsin for president and Senator Burton K. Wheeler of Montana for vice president.

Both Democrats and Progressives urged defeat of the Republicans because of the Harding scandals. Republicans replied with the slogan "Keep Cool with Coolidge." Coolidge and Dawes received more than half of the popular votes cast in the election. On March 4, 1925, Chief Justice William Howard Taft became the first former president to administer the presidential oath of office. Coolidge's inaugural address was the first to be broadcast by radio.

Foreign affairs were marked by two main achievements: the improvement of relations with Mexico and the negotiation of the multilateral Kellogg-Briand Pact to outlaw war (see **Kellogg-Briand Pact**). Coolidge appointed Dwight W. Morrow as ambassador to Mexico. Morrow settled some old disputes and also obtained valuable concessions from Mexico for American and British owners of oil property.

Although Coolidge opposed joining the League of Nations, he favored membership in the World Court. But the Senate placed what he called "unworthy" conditions on membership, and the president let the matter drop. Earlier, in 1923 and 1924, Dawes had directed an international committee that worked out a plan by which Germany could pay its World War I *reparations* (compensation for damages). See **Dawes Plan**.

Life in the White House offered an interesting contrast between the taciturn Coolidge and his lively, charming wife. The difference was particularly noticeable at official receptions.

The president had an interest in many behind-the-scenes details of running the White House. He enjoyed appearing unexpectedly in the kitchen to inspect the iceboxes and to comment on future menus. He once protested mildly because he thought six hams were too many for 60 dinner guests. Coolidge also liked to play practical jokes on the staff. He would ring for the elevator, then stride quickly down the stairs, or push all the buttons on his desk just to see all his aides run in at once.

Tragedy struck the Coolidges shortly after his nomination in 1924. Their son Calvin developed a blister on a toe while playing tennis with his brother on the White House courts. The resulting infection spread, and the 16-year-old youth died of blood poisoning. "When he went," Coolidge wrote in his autobiography, "the power and the glory of the presidency went with him." In 1926, the president's father died.

"I do not choose to run ..." The Coolidges traveled to the Black Hills of South Dakota for a summer vacation in 1927. On August 2, the day before the fourth anniversary of his presidency, Coolidge called newsmen to his office in the Rapid City high school. He handed each reporter a slip of paper on which appeared the words: "I do not choose to run for President in 1928."

Coolidge's announcement caught the nation by surprise, because he had given no clue as to his plans. Coolidge wrote in his autobiography that "The chances of having wise and faithful public service are increased by a change in the presidential office after a moderate length of time." He also mentioned the "heavy strain" of the presidency, and expressed doubt that Mrs. Coolidge could serve four more years as first lady "without some danger of impairment of her strength."

Coolidge had a typical response when reporters asked him to comment upon leaving the capital: "Good-by, I have had a very enjoyable time in Washington."

Quotations from Coolidge

The following quotations come from some of Calvin Coolidge's speeches and writings.

Do the day's work. If it be to protect the rights of the weak, whoever objects, do it.
Speech to the Massachusetts Senate, 1913

And be brief; above all things, Be Brief.
Speech to the Massachusetts Senate, January 1915

There is no right to strike against the public safety by anybody, anywhere, any time.
Telegram to the American labor leader Samuel Gompers during a strike by police in Boston, Sept. 14, 1919

... the chief business of the American people is business.
Speech to the American Society of Newspaper Editors, Washington, D.C., Jan. 17, 1925

This Nation believes thoroughly in an honorable peace. ... It has never found that such a peace could be maintained only by a great and threatening array of arms.
Inaugural Address, March 4, 1925

... no Nation ever had an army large enough to guarantee it against attack in time of peace or insure its victory in time of war.
Speech, Oct. 6, 1925

I do not choose to run for President in 1928.
Statement to reporters, Aug. 2, 1927

Prosperity is only an instrument to be used, not a deity to be worshiped.
Speech in Boston, June 11, 1928

Later years

The Coolidges returned to Northampton, but the stream of tourists past their home made it impossible to

enjoy a quiet life. In 1930, Coolidge bought an estate in Northampton called The Beeches, which had iron gates to keep curious visitors at a distance.

Coolidge published his autobiography in 1929, first in magazine installments, then in book form. The next year, he began writing a series of daily newspaper articles called "Thinking Things Over with Calvin Coolidge." He wrote chiefly about government, economics, and politics. He had become a life trustee of Amherst College in 1921, and was named a director of the New York Life Insurance Company in 1929.

The stock market crash in October 1929, and the resulting nationwide depression distressed Coolidge, who felt that he might have done more to prevent it. But following the renomination of Herbert Hoover in 1932, he said that the depression would have occurred regardless of which party had been in power.

Coolidge became increasingly unhappy as the depression deepened during the fall and winter of 1932. On Jan. 5, 1933, Mrs. Coolidge found him lying on the floor of his bedroom, where he had died of a heart attack. He was buried beside his son and father in the Plymouth Notch cemetery.

Mrs. Coolidge sold The Beeches and built another home in Northampton, where she lived until her death on July 8, 1957. Coolidge had written: "For almost a quarter of a century she has borne with my infirmities, and I have rejoiced in her graces." George H. Mayer

Related articles in *World Book* include:

Dawes, Charles G.
Harding, Warren G.
Hoover, Herbert C.
Mellon, Andrew W.
President of the United States
Roaring Twenties
Vice President of the United States

Outline

I. Early life
- A. Childhood
- B. Education

II. Political and public activities
- A. Entry into politics
- B. As governor
- C. Vice President

III. Coolidge's Administration (1923-1929)
- A. Cabinet
- B. Corruption in government
- C. "Constructive economy"
- D. "Keep Cool with Coolidge"
- E. Foreign affairs
- F. Life in the White House
- G. "I do not choose to run ..."

IV. Later years

Questions

What were some unusual features about Coolidge's inaugurations as President?
What made Governor Coolidge nationally famous?
Why did Coolidge abandon the idea of trying to get the United States into the World Court?
When was the slogan "Keep Cool with Coolidge" used?
Why was Coolidge so popular with the people?
How did the investigations of corruption in government affect Coolidge?
In what ways did Coolidge's outlook on life differ from that of the American people as a whole?
What was Coolidge's most famous statement?
How did Coolidge squelch a woman who had bet that she could get him to chat with her?
What tragedy struck Coolidge during his presidency?

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Cooling system. See Air conditioning.
Coon. See Raccoon.
Coonhound. See Black and tan coonhound.
Cooper. See Barrel.

Cooper, Gary (1901-1961), was an American motion-picture actor who appeared in more than 90 films. His cowboy roles in such movies as *The Virginian* (1929) and *The Westerner* (1940) made him a symbol of the courageous pioneer of the American West. In these and other films, including *Meet John Doe* (1941) and *Friendly Persuasion* (1956), Cooper came to represent the common person fighting evil. Cooper won Academy Awards for his performances in *Sergeant York* (1941) and *High Noon* (1952).


United Press Int.
Gary Cooper

Cooper's real name was Frank James Cooper. He was born in Helena, Montana. He first gained fame as a romantic leading man in such films as *A Farewell to Arms* (1932). He first won critical praise in Frank Capra's sentimental comedy *Mr. Deeds Goes to Town* (1936).
Rachel Gallagher

Cooper, James Fenimore (1789-1851), was an American novelist and social critic. He is best known for *The Leather-Stocking Tales,* five novels about Natty Bumppo, a frontiersman. The character has other names in the series, including Leatherstocking. In *The Leather-Stocking Tales,* Cooper became the first author to seriously portray American frontier scenes and characters.

In *The Leather-Stocking Tales,* Cooper described Natty Bumppo's retreat from the advancing settlement of the forest. The novels introduce Natty Bumppo as a young man and follow him to old age and death. *The Leather-Stocking Tales,* in the order of the hero's life, are *The Deerslayer* (1841), *The Last of the Mohicans* (1826), *The Pathfinder* (1840), *The Pioneers* (1823), and *The Prairie* (1827). These action-filled stories contrast two ways of life. Natty Bumppo and his brave, noble Indian friends live a life of freedom close to nature. The settlers bring civilization and social order, but they also selfishly or thoughtlessly misuse the wilderness.

Cooper's conservative ideas about society are reflected in many of his writings. His works show his concern for the freedom of individuals and the rights of property owners. Cooper declared that he believed in democracy. However, he said he feared that majority rule would bring disorder and injustice. Although he was deeply patriotic, Cooper thought that the United States should be governed by a small aristocracy of cultured and public-spirited landowners.

Cooper wrote several nonfiction works criticizing American life. The best known include the essays *A Let-*

ter to his Countrymen (1834) and *The American Democrat* (1838). He also wrote fiction about his ideals on civic leadership, including *Homeward Bound* (1838) and *Home as Found* (1838). Cooper defends property rights in three novels called *The Littlepage Manuscripts.* They are *Satanstoe* (1845), *The Chainbearer* (1845), and *The Redskins* (1846).

Cooper wrote the first American novel about the sea, *The Pilot* (1823). This romance has a memorable character, Long Tom Coffin, who, like Natty Bumppo, is a daring figure who lives close to nature. Cooper also wrote other historical tales of exciting sea chases.

Cooper was born in Burlington, New Jersey. He was raised in the scenic lakeside community of Cooperstown, New York, which was named for his father, William Cooper. *The Pioneers* and *The Deerslayer* are set in this lake region. Cooper served in the U.S. Navy from 1808 to 1811. He settled in upstate New York, intending to become a gentleman farmer.

Cooper wrote his first novel, *Precaution,* in 1820, but it received little critical praise. His next novel was *The Spy* (1821), a story about families during the Revolutionary War. Its immediate success encouraged Cooper to devote himself to writing. Alan Gribben

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Cooper, Leroy Gordon, Jr. (1927-), a United States astronaut, was the first person to make two orbital space flights. Virgil I. Grissom made two space flights before Cooper did, but Grissom did not orbit the earth during his first flight.

On May 15-16, 1963, Cooper circled the earth 22 times in the Mercury spacecraft *Faith 7.* He and Charles Conrad, Jr., orbited the earth 120 times on Aug. 21-29, 1965, in the Gemini 5 spacecraft. Gemini 5 was the first spacecraft to use *fuel cells,* devices that produce electricity from the chemical reaction between a fuel and oxygen. The flight lasted 190 hours 56 minutes and proved that people could live in a weightless state for the length of a trip to the moon.

Cooper was born in Shawnee, Oklahoma. He attended the University of Hawaii from 1946 to 1949. He received an Army commission through the university's ROTC program but transferred the commission to the Air Force. Cooper graduated from the Air Force Institute of Technology in 1956 and became a test pilot in 1957. He was picked as one of the seven original astronauts in 1959. He resigned from the astronaut program in 1970 and entered private business. Lillian D. Kozloski

See also Space exploration (The first seven U.S. astronauts).

Cooper, Peter (1791-1883), was an American inventor, manufacturer, and philanthropist. He built a locomotive to demonstrate the use of steam power. He also helped develop the American iron industry. Cooper helped Cyrus Field lay the underseas Atlantic Cable, and founded the Cooper Union. The Cooper Union provided free instruction in art, science, and engineering.

Cooper began earning a fortune in the 1820's, when he successfully manufactured glue and gelatin. He stayed in this business all his life. He also invested in real estate. In 1830, he completed his famous locomotive, *Tom Thumb,* which was especially designed for sharp curves and hills. With his son, Edward, and his son-in-law, Abram Hewitt, Cooper pioneered in the manufacture and sale of iron rails and structural iron beams. During the 1850's and 1860's, he helped promote telegraph and cable companies.

Throughout his life, Cooper took an active interest in civic affairs. He worked effectively for public education, improved water supplies, and better police and fire protection. After the Civil War, he supported political and social reforms. He ran for President on the Greenback ticket when he was 85. Cooper published the book *Ideas for a Science of Good Government* (1883).

Cooper was born in New York City, but spent his youth in Peekskill, New York. He soon showed a talent for mechanics and invention. Although he had only a



Baltimore & Ohio Railroad

The *Tom Thumb* was a steam locomotive built by American inventor and manufacturer Peter Cooper. The locomotive, completed in 1830, demonstrated the ability of steam engines to pull railroad cars. A replica of the original is shown here.

limited education, he received a practical training in hatmaking, brewing, and other trades. At 17, he was apprenticed to a coachbuilder, and he later worked as a machine builder. W. Bernard Carlson

See also Railroad (History).

Cooper, Susan (1935-), an English author, won the 1976 Newbery Medal for her novel *The Grey King* (1975). This book was the fourth in her series of mystery stories called *The Dark Is Rising.* The stories tell about several British children and their roles in the struggle between the forces of good and evil. The earlier works in the series were *Over Sea, Under Stone* (1966), *The Dark Is Rising* (1973), and *Greenwitch* (1974). The fifth book, *Silver on the Tree* (1977), ended the series.

Cooper was born in Buckinghamshire. She moved to the United States in 1963. Kathryn Pierson Jennings

Cooperative, *koh AHP ruh tihv,* is a business owned by the people who use its services. Some cooperatives sell goods or services produced by their members. In other cooperatives, farmers or other consumers buy as a group directly from suppliers. By reducing expenses, these organizations often provide lower costs for con-

sumers and higher earnings for producers.

How cooperatives work

Members of the cooperative share equally in controlling the organization. They purchase or earn shares in the cooperative, providing the capital necessary to operate the business. Profits are used to improve the business or are returned to members. The members hold meetings annually to elect directors from among themselves. The directors hire managers to run the day-to-day activities of the cooperative.

Most cooperatives operate under six principles adopted by the International Cooperative Alliance in 1966. These principles are: (1) The cooperative is open to any person who will use its services and accept the responsibilities of membership. (2) Each member has one vote, regardless of how many shares the member holds. (3) The cooperative pays limited interest on its shares. The laws of most states set a maximum of 8 percent interest or less. (4) All profits are returned to members according to how much they use the business. (5) The cooperative educates members to help them in making business decisions. (6) Cooperatives work together at local, regional, national, and international levels to promote the cooperative movement.

Kinds of cooperatives

The chief kinds of cooperatives include (1) supply, or purchasing, cooperatives, (2) marketing cooperatives, (3) housing cooperatives, (4) credit unions, and (5) service cooperatives.

Supply, or purchasing, cooperatives are retail stores owned and operated by some or all of their customers. These cooperatives buy goods from farmers, private manufacturers, or wholesalers. By buying in large quantities, they pay reduced prices. They then sell the goods, usually at regular prices, to the public as well as to members. Members later receive refund payments based on the amount of their purchases.

The main types of supply cooperatives are *consumer cooperatives* and *farm supply cooperatives.* Consumer cooperatives sell food, household supplies, and other goods. Farm supply cooperatives specialize in farm supplies, such as feed, fertilizer, and seed.

Marketing cooperatives are groups of farmers who join together to get higher prices for their products. The cooperatives collect, process, sell, and ship the products of their members. Most of these groups have their own canneries, warehouses, and other facilities. Such cooperatives handle many well-known brands of food. For example, Sunkist is the trademark of a California citrus growers' cooperative. Other well-known cooperative brands include Land O Lakes dairy products, Ocean Spray cranberries, and Sun-Maid raisins.

Housing cooperatives are owned by people who form a corporation to buy the buildings in which they live. The individuals buy shares in the corporation. The shares entitle them to occupy an apartment or house in the cooperative, but they do not actually own their units. The members share maintenance costs.

Credit unions are the most numerous type of cooperative in the United States. They are formed by people with a common bond. For example, the members may work for the same company or belong to the same church or labor union. The members pool their savings. When one of them has to borrow money, he or she may borrow from the union at a low rate of interest.

Service cooperatives provide many services. Electrical cooperatives generate and sell electrical power in rural areas where private power companies cannot make enough profit. Service cooperatives also supply irrigation and telephone service in such areas. Members of a group health cooperative receive medical care for a monthly or yearly fee paid in advance. Other cooperatives provide automobile repair, legal help, and many other services.

Cooperatives around the world

Cooperatives are most common in the industrial nations, including Canada, Japan, the United States, and many countries of Western Europe. The developing nations of Africa, Asia, and Latin America have far fewer such organizations.

In Canada, cooperatives provide farm supplies, health care, housing, loans, and many other goods and services. Most Canadian wheat farmers market their crops through large cooperatives called *wheat pools.*

In other countries, cooperatives are most widespread in the Scandinavian nations—Denmark, Norway, and Sweden. Most of the farmers belong to marketing cooperatives, and all three countries have much cooperative housing. Many Swedes regard cooperatives as halfway between capitalism, in which individuals own industry, and socialism, in which the government owns it. Other nations with many cooperatives include Finland, France, Iceland, Italy, Switzerland, and the United Kingdom.

Israel has two types of cooperative farming settlements, *moshavim* and *kibbutzim.* The farmers in a moshav have their own plots of land, but those in a kibbutz work on a communal farm. Both types of settlements buy supplies and market crops cooperatively.

In North Korea, most farms are cooperatives known as *collective farms.* These farms are controlled by the country's Communist government. Workers on the collective farms receive cash payments and a share of the farms' products. They also may help manage the farms.

History

Most historians trace the beginnings of the modern cooperative movement to the early 1800's. Farmers who wanted more control over the prices they received for their products formed marketing cooperatives. Farmers also formed purchasing cooperatives, in which they pooled their orders for coal, seed, and other products so they could buy in large amounts. A farmers' organization called the National Grange, founded in 1867, promoted both types of cooperatives. The Knights of Labor and other labor unions of the 1800's established consumer cooperatives to provide cheaper goods for low-paid workers.

In the early 1900's, the U.S. government began to support farmer cooperatives. The Capper-Volstead Act of 1922 recognized the right of farmers to form such organizations. It stated that organizing a cooperative did not violate antitrust laws. The Cooperative Marketing Act of 1926 established what is now the Cooperative Services Program. This program of the U.S. Department

of Agriculture helps organize farmer cooperatives and improve their effectiveness.

During the 1960's and 1970's, rising prices created an increased interest in consumer cooperatives. Many people formed small neighborhood cooperatives called *buying clubs* to save money on groceries. The members took turns buying fruits, vegetables, and other foods from farms or wholesale markets and distributed the items among themselves.

Critically reviewed by the National Cooperative Business Association

Related articles in *World Book* include:

Credit union
Farm and farming (Farming as a business)
Farm Credit System
Housing (Cooperative housing)
Kibbutz
National Farmers Union
Owen, Robert
Truck farming

Cooperative education is a method of education that combines classroom studies with practical work experience. Cooperative education programs typically involve formal written agreements between the school and employers. These agreements allow students to hold jobs, usually for pay, that are related to the students' fields of study or career goals. For example, a student in journalism may work for a local newspaper.

A faculty member, frequently called a *cooperative education coordinator,* finds jobs that fit the goals of students and of the cooperative program. The "coop" coordinator and the employer judge the performance of the student, and the student usually receives some form of graduation credit for satisfactory work. Such programs got their name because businesses, industries, and organizations cooperate with schools in employing students. The programs are also called *internships, cooperative work experience, work-study, career exploration, diversified occupations,* and *off-campus experience.*

Cooperative education operates in both colleges and high schools. In the United States, hundreds of thousands of students in high schools, community colleges, and four-year colleges and universities are enrolled in cooperative education programs. Schools in Canada, China, the United Kingdom, and other countries have similar programs.

Cooperative education began in the United States in the early 1900's. Herman Schneider, an engineering professor, developed the first cooperative education program in 1906 for engineering students at the University of Cincinnati. Other schools adopted similar programs during later years. Since 1960, cooperative education has expanded rapidly into all fields of study.

Kinds of programs. Cooperative education programs operate in various ways at different schools. There are four basic kinds of programs: (1) alternating, (2) parallel, (3) field experience, and (4) extended-day.

In alternating programs, the students are divided into two groups. One group attends classes while the members of the other group work at their jobs. After a certain length of time, usually a semester, the two groups exchange places. Therefore, a position is filled continuously.

In parallel programs, each student attends school part of the day and works part of the day. Many high schools and two-year colleges offer such a program.

In field experience programs, all participating students leave school for an extended work assignment. The length of the period spent on the assignment varies from 4 to 10 weeks.

In extended-day programs, students work full-time at a regular paying job and attend school part-time. The students request faculty approval of their employment as a cooperative assignment. With approval, a student receives academic credit for successful performance at work.

Advantages of cooperative education. Cooperative education programs enable students to immediately determine how the information they learn in school is applied at work. Students learn that a job has many requirements, including subject knowledge, good work habits, judgment, and skills in communication and human relations. Students also gain practical experience and develop contacts with employers, which may help them obtain a job after graduation. Some students use the money earned from their cooperative education jobs to pay their school expenses. Edwin L. Herr

See also **Career education.**

Cooperative Extension System is a nationwide educational network in the United States. It is funded by federal, state, and county governments and by private contributions. The system gives instruction and information to individuals and local communities about agriculture, natural resources, nutrition, child care, health care, and the development of community resources. It also includes such youth programs as 4-H and provides problem-solving assistance to local communities.

The Cooperative Extension System includes the Cooperative State Research, Education, and Extension Service (CSREES) of the U.S. Department of Agriculture (USDA), thousands of county extension offices, and one or more land-grant universities in each of the 50 states (see **Land-grant university**). CSREES links research and education programs of the USDA with those of land-grant universities and other institutions. It promotes education and research in the food and agricultural sciences, environmental sciences, and related fields.

Almost every county and many major cities in the United States have at least one extension office. Each office is staffed by one or more extension agents. Volunteers work with the agents. Specialists and researchers at the land-grant universities support the efforts of the extension offices.

The Cooperative Extension System was established in 1914 by the Smith-Lever Act. The first land-grant universities had been endowed under the Morrill Act of 1862.

Raymond J. Miller, Jr.

See also **Agricultural education** (Colleges and universities); **County agricultural extension agent; 4-H.**

Cooperstown (pop. 2,032) is a resort village on Otsego Lake, in the east-central part of New York state. For location, see **New York** (political map). William Cooper, a judge, purchased land and surveyed the wilderness site in 1785 and settled there in 1790. His son James Fenimore Cooper set two of his famous *Leather-Stocking Tales* in the region. Cooperstown was incorporated in 1807.

Cooperstown is the home of the National Baseball Hall of Fame and Museum, which was established in 1939. Many people then believed that baseball had been invented in Cooperstown by Abner Doubleday in 1839 (see **Baseball** [The Abner Doubleday Theory]; **Double-**



National Baseball Hall of Fame

Cooperstown is the home of the National Baseball Hall of Fame and Museum. The Hall of Fame and Museum honors great baseball players and features historic displays of the game.

day, Abner). Fenimore House and the Farmers' Museum also attract many visitors. Fenimore House is a museum of American folk art. The Farmers' Museum re-creates early American farm life. John Kenneth White

Coot is the name of nine kinds of marsh birds in the rail family. Coots are sometimes called *mud hens* or *marsh hens*.

Coots have slate-gray feathers, and they resemble ducks. They range in size from about 13 to 23 inches (33 to 58 centimeters) long. Coots have short, rounded wings and a white or yellow bill that is shaped like a chicken's bill. Fleshy, paddlelike flaps on their toes help them swim.

Coots live all over the world except the polar regions. The American coot is found from southern Canada to South America. The European coot, a species common in Europe and Asia, occasionally strays to Newfoundland and Labrador.



WORLD BOOK illustration by John Rignall, Linden Artists Ltd.

The coot is a dark gray water bird that resembles a duck. The American coot, *above,* lives in the Western Hemisphere.

Most coots live in freshwater marshes. They build floating nests from dead plants. The female usually lays 9 or 10 eggs. Coots feed chiefly on algae and the seeds, leaves, and roots of other water plants. They also eat snails, worms, water insects, small fish, and tadpoles. Coots find their food on the surface of the water and on the ground, or they dive underwater to obtain it. Other birds often steal food that coots have obtained by diving. James J. Dinsmore

Scientific classification. Coots belong to the rail family, Rallidae. The scientific name for the American coot is *Fulica americana.* The European coot is *F. atra.*

See also **Rail**.

Cop. See **Police** (introduction).

Copán, *koh PAHN,* was one of the southernmost Maya cities during the Classic Period of the Maya, which lasted from about A.D. 250 to 900. The city's ruins lie in western Honduras (see **Honduras** [map]). Copán's development as an important Maya center began about A.D. 400. Its population peaked at more than 20,000 about A.D. 800.

From the early 400's to 820, a series of 16 kings ruled Copán. All of them belonged to a single *dynasty* (family). Copán traded with Teotihuacán in what is now Mexico and with the Maya cities of Tikal and Kaminaljuyú, whose ruins lie in Guatemala.

Copán included a ceremonial center that had plazas, altars, and pyramids with temples on top. The city also contained carved stone monuments that were covered with royal portraits and *hieroglyphics* (picture writing). The monuments were devoted to the history and religion of Copán. The people of Copán worshiped a number of gods. The deities included corn, fire, and rain gods.

Copán started to decline after A.D. 822. The decline may have been caused in part by internal revolts. By 1200, few people lived in the area. Today, Copán is a major tourist attraction and archaeological site.

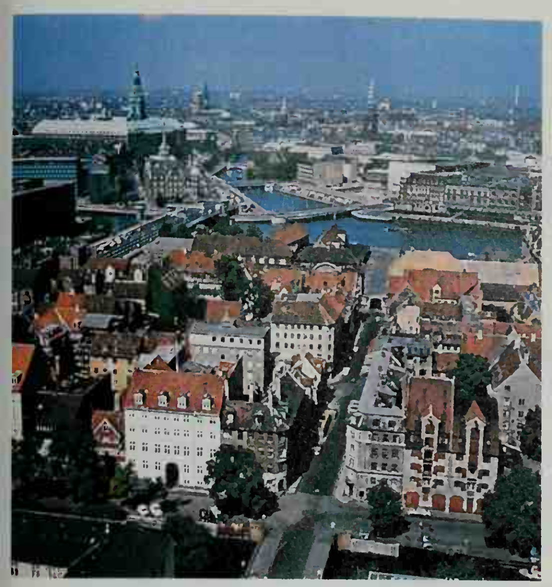
Jose A. Fernandez Valbuena

See also **Honduras** (History); **Maya**.

Copenhagen, *KOH puhn HAY guhn* or *KOH puhn HAH guhn* (pop. 464,566; met. area pop. 1,339,395), is the capital and largest city of Denmark. Its name in Danish is *København.* The city is Denmark's major port and chief economic, political, and cultural center. About a fourth of the Danish people live in the Copenhagen area. Some parts of Copenhagen lie on the east coast of the island of Sjælland. Other sections are on Amager, an island just east of Sjælland. For location, see **Denmark** (political map).

The city. Town Hall Square lies in the heart of Copenhagen. The city's main streets and highways extend outward from the square, and a number of bus and train routes run through the area. Many office buildings and hotels are near the square, as is the famous Tivoli Gardens amusement park. Tivoli Gardens offers various forms of entertainment, including rides, ballet, and concerts.

A mall called Strøget extends between Town Hall Square and the King's New Market, another major square. Strøget, which is closed to motor traffic, has de-



J. Messerschmidt, Bruce Coleman Inc.

Copenhagen is the capital and largest city of Denmark. The city is the nation's major port and serves as the center of Denmark's economic, political, and cultural activity.

partment stores, small shops, and sidewalk cafes. East of Town Hall Square is Christiansborg Castle, which houses Parliament and the Supreme Court. The National Archives and Royal Library are located near Christiansborg castle.

A world-famous statue called *The Little Mermaid* is in Copenhagen's harbor. It represents a character from a fairy tale by the Danish author Hans Christian Andersen. Other attractions include the Amalienborg Palace, the Stock Exchange, and the New Carlsberg and Thorvaldsen museums. Copenhagen is the home of the Royal Danish Ballet. The University of Copenhagen, Denmark's oldest university, was founded in 1479.

Economy. Copenhagen is the commercial and industrial center of Denmark. The city's products include beer, diesel engines, furniture, and porcelain. Trade is also important to the economy of Copenhagen.

Buses and commuter trains provide most public transportation in Copenhagen. Many people ride bicycles, and most of the major streets have special bicycle paths. An international airport lies near the city.

History. In the mid-1000's, Copenhagen was a small fishing village. It became a trade center because of its harbor and, by the 1100's, had developed into a town. It was chartered in 1254 and grew increasingly important economically during the next few centuries. Copenhagen became the capital of Denmark in 1443.

During various periods from about 1250 to 1810, fires and wars destroyed much of Copenhagen, and epidemics killed many of the city's people. Copenhagen recovered each time, however, and continued to grow as an economic, military, and political center.

Copenhagen expanded to the north and west in the 1850's. During the late 1800's, the city experienced rapid economic growth and began to industrialize. A *free port* was established in the city in 1894 (see Free trade zone). German troops occupied Copenhagen from 1940 to 1945, during World War II, but the city suffered little damage. M. Donald Hancock

See also **Denmark** (pictures).

Copepod, *KOH puh pahd,* is the name of a large group of tiny animals that live either in the ocean or in fresh water. There are more than 7,500 species of copepods. They form part of the *plankton,* the mass of small organisms usually found at or near the water surface (see Plankton). Copepods can swim, but many of the smaller species cannot swim strongly enough to avoid being carried about by water currents. They feed on floating microscopic organisms and plant life. Copepods are an important source of food for many fish, especially herring. Jonathan Green

Scientific classification. Copepods make up the class Copepoda in the subphylum Crustacea, phylum Arthropoda.

See also **Crustacean; Animal** (picture: Animals of the oceans).

Copernicus, *koh PUR nuh kuhs,* **Nicolaus,** *NIHK uh LAY uhs* (1473-1543), was a Polish astronomer who developed the theory that the earth is a moving planet. He is considered the founder of modern astronomy.

In Copernicus's time, most astronomers accepted the theory the Greek astronomer Ptolemy had formulated nearly 1,400 years earlier. Ptolemy had said that the earth was at the center of the universe and was motionless. He had also stated that all the observed motions of the heavenly bodies were real and that those bodies moved in complicated patterns around the earth.

Some astronomers before Ptolemy had suggested that the earth did in fact move. The Greek astronomer Aristarchus had even suggested that the earth and all the other planets moved around the sun. By Ptolemy's time, however, these theories had been rejected. Copernicus knew about some of these early theories. He also believed that Ptolemy's theory was too complicated. He decided that the simplest and most systematic explanation of heavenly motion required that every planet, including the earth, revolve around the sun. The earth also had to spin around its axis once every day. The earth's motion affects what people see in the heavens, so real motions must be separated from apparent ones.

Copernicus skillfully applied this idea in his masterpiece, *On the Revolutions of the Heavenly Spheres* (1543). In this book, he demonstrated how the earth's motion could be used to explain the movements of other heavenly bodies. Copernicus could not prove his theory, but his explanation of heavenly motion was mathematically strong and was less complicated than Ptolemy's theory. By the early 1600's, such astronomers as Galileo in Italy and Johannes Kepler in Germany began to develop the physics that would prove Copernicus' theory correct.

Copernicus was born in Thorn (now Toruń, Poland). He attended the University of Kraków. Through the influence of his uncle, he was appointed a *canon* (church official) of the cathedral chapter of Frauenburg (now Frombork, Poland). He used the income from this position to study law and medicine at the universities of Bologna, Padua, and Ferrara in Italy from 1496 to 1506. When he returned to Poland in 1506, he served as canon.

A. Mark Smith

See also **Astronomy** (Sun-centered theories); **Galileo;**

Kepler, Johannes; Planet (How planets move); Ptolemy.

Additional resources

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Copland, *KOHP luhnd,* **Aaron,** *AIR uhn* (1900-1990), was an American composer who wrote in many styles and forms. He won the 1945 Pulitzer Prize for music for the ballet *Appalachian Spring* (1944). In 1949, he received an Academy Award for his music for the motion picture *The Heiress* (1948).

Several of Copland's early works show the influence of French and middle European music of the early 1900's. He also emphasized jazz in such early works as *Music for the Theater* (1925), for small orchestra, and his *Piano Concerto* (1926). From the mid-1930's to the mid-1940's, Copland incorporated folk music into his compositions. *El Salón Mexico* (1937), an orchestral work, uses traditional Mexican themes. His music for the ballets *Billy the Kid* (1938) and *Rodeo* (1942) includes folk songs of the American West. He blended elements of his earlier styles in *Symphony No. 3* (1946). Beginning in the early 1950's, he revived the lean, severe style of some of his earlier works. His work during this period includes *Piano Fantasy* (1957).

Copland was born in the Brooklyn section of New York City. His parents were Russian Jews, and he used Jewish themes in such compositions as *Vitebsk* (1929) for cello, piano, and violin. He wrote several books to promote acceptance of modern music. These books include *What to Listen for in Music* (rev. ed. 1957) and *The New Music, 1900-1960* (rev. ed. 1968). He also wrote two volumes of autobiography, *Copland 1900 Through 1942* (1984) and *Copland Since 1943* (1990). Richard Jackson

Copley, *KAHP lee,* **John Singleton** (1738-1815), is generally considered the greatest portrait painter in colonial America. His many superb portraits capture the character of Americans in settings of everyday life. He painted with remarkable directness and vitality, making rich use of color, texture, and light and shade.

Copley was born in Boston. In 1766, he sent *Boy with a Squirrel* to a London exhibition. The painters Sir Joshua Reynolds and Benjamin West praised this charming portrait and recommended that Copley study in Europe. Copley was having great success in America, so he put off going to London until 1774. He settled there permanently, and his portraits soon took on the brilliant looser brushwork and atmospheric quality characteristic of British painting.

In 1778, Copley began a career as a painter of historical subjects, fulfilling a lifelong ambition. He painted many historical works, the most successful being *Watson and the Shark* (1778) and *The Death of Lord Chatham* (1781). After 1790, Copley's work gradually declined.

In the past, critics praised Copley's straightforward, vivid American portraits and were critical of the lavish portraits and large historical paintings he did in England. Today critics still praise his American works, but they view his English works with less disfavor than in the past. Elizabeth Garrity Ellis

See also **Hancock, John** (picture); **United States** (The arts [picture]).

Copper has been one of the most useful metals for over 7,000 years. Today, the uses of this reddish-orange metal range from house gutters to electronic guidance systems for space rockets.

Copper is the best low-cost conductor of electric current. So, the electrical industry uses about 60 percent

National Gallery of Art, Washington, D.C., Andrew W. Mellon Fund

Copley's family portrait was painted in 1776. The picture shows Copley, his wife and their four children, and the artist's father-in-law. Copley's careful composition and his delicate handling of color make this one of his finest paintings.

How copper metal is produced

Milling begins when a crusher reduces copper ore to small pieces. Water is added to form a mixture called *slurry.* A ball mill grinds the crushed ore in the slurry into fine particles. The particles become concentrated in a flotation cell.

Smelting removes many impurities from the copper concentrate. A flash furnace eliminates impurities in the form of gases and *slag* (solid waste), producing copper matte. A converter further purifies the molten copper.

Electrolytic refining uses slabs cast from the molten copper supplied by the converter. During this refining process, an electric current produces chemical reactions, which yield copper metal that is over 99.9 percent pure.

Final processing consists of melting and casting the copper metal into cakes, billets, rods, and ingots. Such forms are used to manufacture various copper products, including kitchen utensils, pipes, wires, and brass hinges.

WORLD BOOK diagram by Garri Budynsky, Artisan

of the copper produced, chiefly in the form of wire. Copper wire carries most of the electric current inside homes, factories, and offices. Large amounts of copper wire are used in telephone systems, as well as in television sets, motors, and generators.

Combined with other metals, copper forms such alloys as brass and bronze (see **Brass; Bronze**). Copper and its alloys can be made into thousands of useful and ornamental articles. In the home, copper serves as a basic material for locks, pipe, plumbing fixtures, doorknobs, and drawer pulls. Other commonly used copper products include lamps, pots, pans, roofing, and jewelry.

Chemical compounds of copper help improve soil and destroy harmful insects. Copper compounds in paint serve as pigments and help protect materials against corrosion. Also, copper in small amounts is vital to all plant and animal life.

In ancient times, one of the chief sources of copper for the peoples near the Mediterranean Sea was the island of Cyprus. As a result, the metal became known as *Cyprian metal.* Both the word *copper* and the chemical symbol for the element, *Cu,* come from *cuprum,* the Roman name for Cyprian metal.

Properties of copper

The physical properties of copper make the metal valuable to industry. These properties include (1) conductivity, (2) malleability, (3) ductility, and (4) resistance to corrosion.

Conductivity. Copper is perhaps best known for its ability to conduct electric current. Silver is the only better conductor, but silver is too expensive for common use. Copper alloys do not conduct current nearly as well as pure copper.

Impurities in refined copper greatly reduce electrical conductivity. For example, as little as $\frac{5}{100}$ percent arsenic cuts the conductivity of copper by 15 percent. Copper is also an excellent conductor of heat. This property makes it useful in cooking utensils, radiators, and refrigerators.

Malleability. Pure copper is highly *malleable* (easy to shape). It does not crack when hammered, stamped, forged, or spun into unusual shapes. Copper can be *worked* (shaped) either hot or cold. It can be rolled into sheets less than $\frac{1}{500}$ inch (0.05 millimeter) thick. Cold

Properties of pure copper

Cu Chemical symbol		
	Atomic number	29
	Atomic weight	63.546
	Density (at 20 °C)	8.96 (g/cm³)
	Melting point	1083.4 °C
	Boiling point	2567 °C

Leading copper-mining countries

Tons of copper produced in a year

Country	Production
Chile	4,069,000 tons (3,691,400 metric tons)
United States	2,050,000 tons (1,860,000 metric tons)
Indonesia	861,000 tons (781,400 metric tons)
Canada	779,000 tons (706,700 metric tons)
Australia	666,000 tons (604,000 metric tons)
Peru	574,000 tons (521,000 metric tons)
Russia	568,000 tons (515,000 metric tons)
China	525,000 tons (476,400 metric tons)
Poland	457,000 tons (415,000 metric tons)
Mexico	376,000 tons (340,700 metric tons)
Kazakhstan	372,000 tons (337,400 metric tons)
Zambia	353,000 tons (320,100 metric tons)

Figures are for 1998.
Source: U.S. Geological Survey.

rolling changes the physical properties of copper and increases its strength.

Ductility. Copper possesses great *ductility,* the ability to be drawn into thin wires without breaking. For example, copper rod that is $\frac{7}{16}$ inch (1 centimeter) in diameter can be heated, rolled, and drawn into a wire that is thinner than a human hair.

Resistance to corrosion. Copper is quite resistant to corrosion. It will not rust. In damp air, it turns from reddish-orange to reddish-brown. After long exposure, copper becomes coated with a green film called *patina,* which protects it against further corrosion.

Other properties. Cold-rolled copper has a *tensile strength* from 50,000 to 70,000 pounds per square inch (3,500 to 4,900 kilograms per square centimeter). A material's tensile strength is the maximum stress it can withstand before breaking. Copper keeps its strength and toughness up to about 400 °F (204 °C).

Copper ores

Seven kinds of ores provide most of the world's copper. These ores also may contain other metals, such as lead, zinc, gold, cobalt, platinum, and nickel. Copper ores usually contain less than 4 percent copper. Some ores may yield as little as 0.2 percent copper.

The chief copper ores are *sulfides* (sulfur compounds). They include bornite, chalcocite, and chalcopyrite. *Oxidized ores,* such as azurite, cuprite, and malachite, also yield valuable amounts of copper. Almost pure copper, called *native* copper, rarely occurs in nature. Native copper supplies only a small percentage of the world's total copper production.

Sources of copper

About 11 million tons (10 million metric tons) of copper are mined each year throughout the world. Every continent has copper deposits. Much of the world's copper comes from the mountain ranges extending from Alaska to the tip of South America.

In some places, miners dig copper ore from mines far below the earth's surface. Elsewhere, they remove it from huge open pits at the surface. In *open-pit* mining, big power shovels or other machines remove ore from wide "steps" 40 to 70 feet (12 to 21 meters) high. Most copper mined in the United States comes from open pits. See **Mining** (picture: In an open-pit copper mine).

Leading producers. Chile is the world's leading copper-producing nation, mining about a fourth of the world's supply. Large mines near Santiago and in the Atacama Desert provide most of Chile's copper.

The United States, ranking second in world production, mines about a fifth of the world's copper. But it uses more copper than it mines, and it imports copper from such countries as Canada, Chile, and Peru. Most of the copper mined in the United States comes from Arizona. The Keweenaw Peninsula in Michigan is one of the few remaining sources of native copper.

Canada ranks fourth among copper-producing nations. Most Canadian copper comes from British Columbia and Ontario. The area around Greater Sudbury in Ontario has the largest copper deposits in Canada. Manitoba and Quebec also produce significant amounts of copper.

Australia, Indonesia, Peru, and Russia are also important copper producers. Large copper deposits also occur in China, Kazakhstan, Mexico, Poland, and Zambia.

Recycling. Copper is readily recycled from scrap wire, motors, automobile radiators, and electronic equipment. Recycled scrap supplies about one-fourth of the U.S. copper requirement.

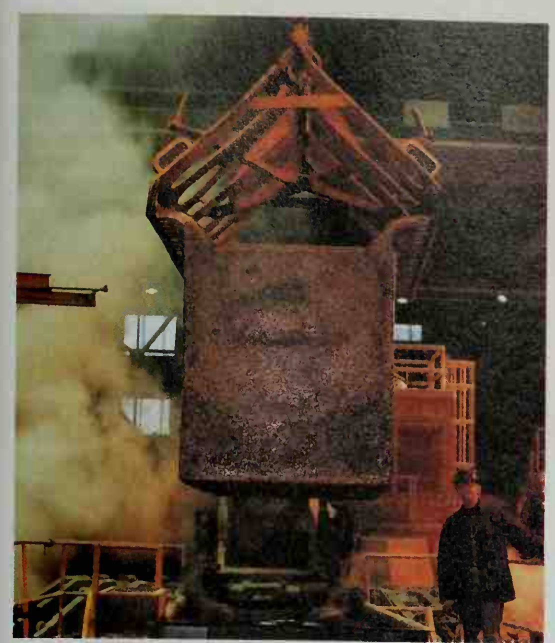
Obtaining copper from the ore

At the mine, large power shovels load the copper ore, frequently in the form of big boulders, into trucks or railroad cars. These vehicles carry the ore to mills. Not all ores go through exactly the same processes. However, all the processes are designed to separate valuable minerals from the ore and waste rock, to extract copper and other metals that may be in the resulting mixture, and to purify these metals.

In a typical process, the ore is sent to the mill, where it is crushed and the waste rock removed. The resulting material is then sent to the smelter, where the metallic copper is separated from impurities. This copper may contain other metals, such as gold, silver, and nickel, that must be removed by refining.

Milling starts in a *crusher,* where the ore is broken into small pieces. Then water is added to the crushed ore to form a souplike mixture called *slurry.* The slurry passes into *ball mills,* which are rotating, drum-shaped cylinders partially filled with iron balls. As the cylinders rotate, the balls grind the ore into particles small enough to pass through a screen with 10,000 openings per square inch (1,600 openings per square centimeter).

The slurry next goes through a *flotation process* that concentrates the mineral-bearing particles. The slurry



Kennecott

A copper anode is a large, rectangular cake of blister copper used in the electrolytic refining process to produce copper that is more than 99.9 percent pure.

first passes into tanks called *flotation cells.* There, chemicals and oil are added, and the entire mixture is agitated with air to make it bubble. One chemical makes the bubbles stable. Another coats the mineral particles so that they stick to the bubbles. The bubbles rise to the top of the cell with the particles and form a froth. This froth is skimmed off and dried. The product, called *copper concentrate,* may contain from 15 to 33 percent copper. The waste material, called *tailings,* does not become attached to the bubbles. It is emptied from the lower part of the flotation cell and sent to storage ponds.

Smelting removes most of the remaining impurities from the copper. In smelting, copper concentrate is dried, then blown with air and pure oxygen into a *flash smelting furnace.* Such a furnace can smelt as much as 3,000 short tons (2,700 metric tons) of copper concentrate per day. In the furnace, the concentrate burns and melts, releasing some impurities in the form of sulfur dioxide gas. The *molten* (melted) material falls to the bottom of the furnace, where it separates into *slag* and *copper matte.* Slag, which contains iron oxide, silica, and other impurities, rises to the surface. The slag is discarded. Copper matte is heavier and collects under the slag. Copper matte contains from 50 to 75 percent copper. It also contains some impurities in the form of iron sulfide and other metals.

In the next stage of the process, the molten matte goes through a *converter.* In the converter, blowers force air through it, and silica is added. The silica combines with the impurities, forming slag. The slag is again skimmed from the top. The new mixture is called *blister copper* because the surface blisters as the copper cools. Blister copper is from 97 to 99.5 percent pure.

The blister copper is refined in a *fire-refining furnace.* This furnace removes most of the remaining impurities, mainly oxygen. In a process called *poling* or *reduction,* natural gas is blown into the *melt* (furnace load) of molten copper. As the natural gas burns, oxygen and other gases are removed from the copper. The resulting copper is 99.9 percent pure.

Electrolytic refining. Copper to be used in electrical conductors must be electrolytically refined to a purity of more than 99.9 percent. To do this, fire-refined copper is cast into cakes about 3 feet (91 centimeters) square and 2 inches (5 centimeters) thick. The cakes serve as *anodes* (positive poles) in the electrolytic process. For a discussion of this process, see Electrolysis.

The copper anodes are put into tanks containing a solution of copper sulfate and sulfuric acid. They are suspended alternately with *cathodes* (negative poles), which are thin sheets of pure copper called *starter sheets.* When an electric current passes through the tank, the anode bars gradually dissolve, depositing copper more than 99.99 percent pure on the cathodes. Most of the remaining impurities in the anodes settle to the bottom of the tank and form a *sludge.* Processors use various methods to recover gold, silver, platinum, and other metals from the sludge. After electrolysis, the copper cathodes are usually melted in a furnace and cast into various shapes and sizes, such as rods, cakes, ingots, and billets.

Leaching is a method of dissolving metal out of ore with a chemical solvent. Leaching recovers copper from ores that do not react to the chemicals used in the flotation process. In leaching, water containing sulfuric acid or other chemicals circulates through the ore and dissolves the copper. The solution is then mixed with a kerosene solvent containing chemicals that extract the copper. The mixture separates and the copper-bearing chemicals flow into a sulfuric acid solution. This solution is put into a tank to undergo *extraction-electrowinning,* a process similar to electrolytic refining. The resulting copper is about 99.9 percent pure.

Making copper products

Fabricating plants, such as brass and wire mills, make semifinished forms including sheets, tubes, and wires. They make these forms from copper rods, cakes, ingots, and billets. Manufacturers of copper products buy the semifinished forms from these plants.

Copper sheets are rolled from copper cakes that measure about 25 inches (64 centimeters) wide, 8 inches (20 centimeters) thick, and up to 72 inches (183 centimeters) long. The cakes are heated in a furnace to about 1700 °F (926 °C), then rolled on a hot mill into sheets about $\frac{1}{2}$ inch (13 millimeters) thick. Other mills finish the sheets by rolling them to exact thicknesses. The sheets are then cut into pieces of the required size to make such products as roofing sheets and cooking utensils.

Copper tubes are made from copper billets that vary in diameter from 3 to 9 inches (8 to 23 centimeters) and are up to 52 inches (132 centimeters) long. Workers heat the billets in a furnace, then pierce them to produce a rough pipe. The pipe shells thus formed are forced through round holes in *dies* (metal plates) and over other devices to produce tubes of the required size. The tubes are used to make plumbing pipes, household gas

lines, and electrical conduits.

Copper wire is produced by melting copper cathodes and casting the molten copper into a bar about 4 inches (10 centimeters) wide and 3 inches (7.5 centimeters) thick. The bar is rolled into a rod about $\frac{5}{16}$ inch (0.8 centimeter) in diameter and then coiled into large rolls. The rod is then pulled through a wire-drawing machine. This machine reduces the rod to the desired wire size. Most copper wire is used to carry electric current.

Extruded copper. Some copper is *extruded* (squeezed) through a hole in a die to form the desired shape. Copper can be extruded into rods, tubes, and other special shapes. These are made into hinges, drawer pulls, and other pieces of hardware.

History

Copper was one of the first metals known to human beings. It came into use because early peoples found it in native condition and could easily beat it into small tools, weapons, and ornaments.

Early civilizations. Copper was probably first used about 8000 B.C. by people living along the Tigris and Euphrates rivers in the Middle East. As early as about 5000 B.C., people throughout the Middle East knew how to heat and hammer copper into sheets to make larger tools, weapons, and ornaments. Copper was later used by many peoples, including the Chinese and the American Indians.

About 3500 B.C., people discovered how to melt copper with arsenic to make bronze. At about that same time, they learned to smelt copper from ore. From about 3000 B.C. to about 1100 B.C., bronze made with tin instead of arsenic became important (see **Bronze Age**). The process of combining zinc with copper to make brass was probably discovered sometime after 1000 B.C. The Romans started making brass coins in the 100's B.C.

Industrial developments. From early times until the A.D. 1800's, ample high-grade ore was available, and methods for processing and using copper changed only slightly. By the late 1800's, the rapid growth of electric lighting and telephone and telegraph systems had greatly increased the demand for copper, which dwindling deposits of high-grade ore could not meet. Also, most native copper deposits had been used up.

Geologists had located large ore deposits in the United States and Chile. But the copper content of the ore was so low that the ore could not be processed at a profit. About 1900, a young American mining engineer in Utah, Daniel C. Jackling, realized that low-grade ores could be processed cheaply by using mass-production methods. His process involved the use of steam shovels to strip off surface rock. Other special mass-production equipment was used for smelting and refining. New techniques for separating copper from the ore also increased the supply of available copper. David B. George

Related articles in *World Book* include:

Copper products

Brass	Monel metal	Wire
Bronze	Nickel silver	

Other related articles

Alloy	Chalcocite	Malachite
Arizona (Mining)	Chalcopyrite	Mineral (picture)
Azurite	Chile (picture)	

Additional resources

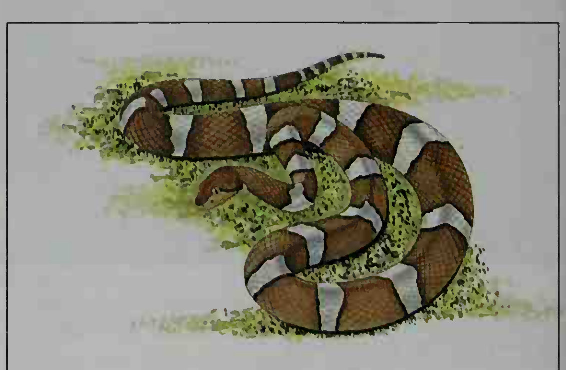
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Copperhead is a poisonous American snake, one of the pit vipers. Its body has broad chestnut-red bands. Most copperheads are about 2 $\frac{1}{2}$ feet (76 centimeters) long. The largest grow to about 4 feet (1.2 meters).

The copperhead bites people more often than most rattlesnakes, partly because it is silent and smaller, and is not so quickly noticed. The bite is seldom fatal to adults but can seriously poison children who weigh less than 75 pounds (34 kilograms). This reptile usually eats rodents and other small mammals. The prey are killed with the poison and swallowed whole. Sometimes the snake eats insects and frogs. It gives birth to from three to seven young in August or September.



WORLD BOOK illustration by Richard Lewington, The Garden Studio

The copperhead is a poisonous American snake. It can be recognized by the broad chestnut-colored bands along its body.

The copperhead lives south of a line from the northeastern tip of Massachusetts through Pittsburgh to the southeastern corner of Nebraska. From there the line passes southwest to the upper Rio Grande in Texas. In this area, any snake is likely to be called a copperhead if its markings resemble one. But copperheads can be told from nonpoisonous snakes by a pit they have in front of and below each eye. The snake's nostril is in front of the pit. The copperhead has no rattle on the end of its tail and therefore differs from rattlesnakes. Laurie J. Vitt

Scientific classification. The copperhead belongs to the viper family, Viperidae. It is *Agkistrodon contortrix.*

See also Snake (pictures); **Viper**.

Copperheads was a name given to a group of Democrats who criticized President Abraham Lincoln's Administration during the American Civil War (1861-1865). Loyal Unionists claimed the Copperheads were pro-Southern and reminded them of the poisonous snakes with the copper-colored heads. Copperheads cut the head of Liberty from the copper cent and wore it proudly as a badge.

Copperheads opposed Lincoln's attempts to free the slaves in the South. They spoke out against political arrests and the military draft and favored compromise

with the Confederate States to end the war. The movement reached its peak early in 1863. But Union military victories and Republican election victories in 1864 helped to end the movement. Frank L. Klement

See also **Seymour, Horatio; Sons of Liberty; Vallandigham, Clement L.**

Coppola, *KAHP uh luh,* **Francis Ford** (1939-), is an American motion-picture director, producer, and writer. Many of his films paint a grim picture of modern society. His most important movies include *The Godfather* (1972), *The Godfather, Part II* (1974), and *The Godfather, Part III* (1990), which cover almost 100 years in the life of an American family involved in organized crime. His *Apocalypse Now* (1979) was the first major American movie to deal with the Vietnam War. It was reissued in 2001 in an expanded version called *Apocalypse Now Redux.* Coppola won Academy Awards for co-writing the screenplays for *Patton* (1970) and the first two *Godfather* movies, and for directing *The Godfather, Part II.*



© Tom Zimberoff, Gamma/Liaison
Francis Ford Coppola

Coppola was born on April 7, 1939, in Detroit. He received a Master of Cinema degree from UCLA in 1968. His film *You're a Big Boy Now* (1966) was his master's thesis. He became the first major American director to begin his career from a university program in filmmaking. His success created opportunities for other college-trained filmmakers. Coppola's other films include *The Conversation* (1974), *The Outsiders* (1983), *Peggy Sue Got Married* (1986), *Tucker: The Man and His Dream* (1988), *Bram Stoker's Dracula* (1992), and *The Rainmaker* (1997). Gene D. Phillips

Copra, *KAHP ruh* or *KOH pruh,* is the dried meat of the coconut. Copra is valuable for its oil, which is used in the manufacture of soap, candles, margarine, detergents, cosmetics, and other products. Copra is one of the main exports of islands in the Pacific Ocean.

Coconut meat is dried in the sun or in ovens called *kilns,* or by using hot air. Drying removes water from the meat, allowing the meat to keep for a longer time.

The oil in copra is pressed out. The remaining cake, called *coconut-stearin* or *poonau,* is used for fodder and poultry feed. Copra yields from 50 to 65 percent of its weight in oil. Thirty average coconuts produce about 1 gallon (3.8 liters) of oil. Michael J. Tanabe

See also **Coconut palm; Pacific Islands** (picture: Producing copra).

Copts, *kahpts,* is a term first used to refer to certain native residents of ancient Egypt. The Copts spoke a version of the ancient Egyptian language enriched by many Greek words and written with a modified Greek alphabet. The name Copts also refers to members of the Coptic Orthodox Church in modern Egypt, who use the Coptic language in their church service. However, like other Egyptians today, Copts speak Arabic.

The Copts played a leading role in the development of the early Christian church. They made their most important contribution to Christianity from the late A.D. 200's to the mid-300's, when a Copt, Anthony of Thebes, founded the early Christian monastic movement. The Copts were interested in the lives and sayings of the saints. Most surviving Coptic literature concerns this subject. The Copts stressed the unity of the human and divine in Christ's nature, a belief known as the *Monophysite doctrine.* At the Council of Chalcedon in 451, however, church leaders from Rome and Constantinople declared Christ had two separate natures and condemned the powerful Coptic *patriarchate* (ruling division) in Alexandria. Some Copts submitted to the Council's decisions, but most chose to establish an independent church with its own patriarch and clergy.

In 642, Muslim Arabs conquered Egypt, and many Copts converted to Islam. Today, only a few million Copts live in Egypt, while other small Coptic communities are scattered throughout the world. In the 1970's, Coptic church leaders met with various Eastern Orthodox Churches and the Roman Catholic Church to explore the possibility of reunion. Patrick T. R. Gray

Copying machine is any of several types of devices that copy documents or illustrations. Other devices, called *duplicators,* also produce copies. But duplicators use a special form called a *master* or *plate,* while copying machines do not require a master (see **Duplicator**).

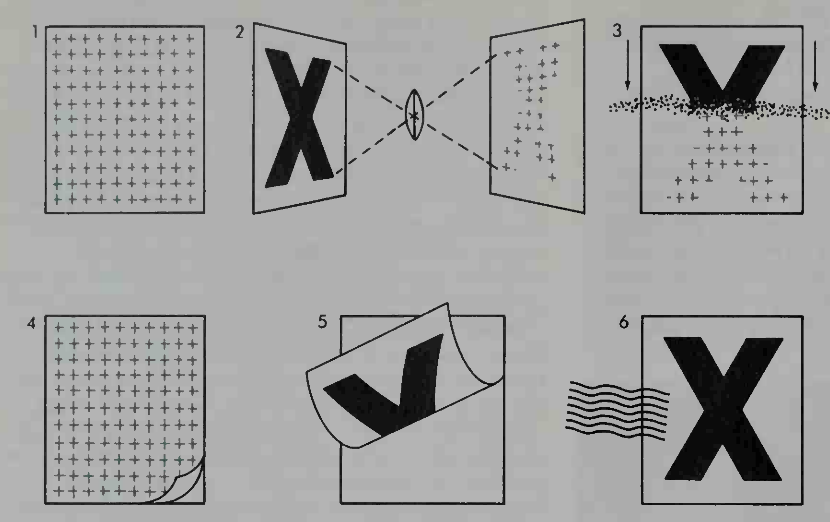
Manufacturers produce a wide variety of copiers, from personal copiers that make 5 to 8 copies a minute to units that can produce 180 copies a minute. Special features include automatic document feeding and sorting, image reduction and enlargement, *duplexing* (two-sided copying), color copying, and stapling. Some color copiers produce copies in black and one other color. Others produce full-color copies.

The chief methods of copying are (1) electrostatic copying, (2) inkjet copying, (3) projection copying, and (4) contact copying. Most copying machines use the electrostatic method.

Electrostatic copying was invented in 1938 by Chester F. Carlson, an American physicist. Unlike earlier methods, which required liquid developers, Carlson's process was completely dry. It became known as *xerography,* a term that comes from two Greek words meaning *dry* and *writing.*

In xerography, a drum, belt, or plate coated with the element selenium or some other light-sensitive material is charged with static electricity. A light source forms a positively charged image on the light-sensitive surface corresponding to the dark areas of the *original,* the document or illustration to be copied. In *analog xerography,* light reflected from the original passes through a lens to strike the light-sensitive surface. In *digital xerography,* laser light charges the surface. The remainder of the surface loses its charge. Next, negatively charged *toner* (powdered ink) is dusted onto the surface. Because oppositely charged materials attract each other, toner sticks to the image. The inked image is then transferred to positively charged paper and heated for an instant. The toner melts, creating a permanent copy.

Digital xerography developed from tools common in *desktop publishing,* the use of computers to produce printed materials. Most digital copiers combine a *scanner* with a *laser printer.* The scanner uses light sensors and other devices, or a digital camera, to convert the image on the original to a *digital* (numeric) file. The laser



Electrostatic copying of a document involves six basic steps. (1) A light-sensitive surface receives a positive electric charge. (2) Light reflected from the document passes through a lens and strikes the light-sensitive surface. This step leaves a positive charge only in the area that corresponds to the image on the document. (3) Negatively charged, powdered ink is then dusted on. Because oppositely charged materials attract each other, the ink sticks to the image area. (4) A piece of paper is placed over the surface and given a positive charge. (5) The ink is attracted to the paper. (6) Heat fuses the ink to the paper, creating the copy.

WORLD BOOK illustration by Linda Kinnaman. Source material from Xerox Corporation.

printer uses a laser to charge a drum in a pattern that corresponds to the original. Many digital copiers can transmit digital files representing documents to other digital devices, such as fax machines and personal computers. Some also send and receive fax messages.

Inkjet copying is done by digital copiers that use tiny nozzles to spray droplets of ink onto the printing surface in a pattern corresponding to the original. Inkjet copiers are generally used for low-volume desktop copying. Beginning in the mid-1900's, several people and companies contributed to the development of inkjet copying.

Projection copying was developed in the mid-1800's. Projection copiers include the copy camera and the photostat machine. A *copy camera* performs the steps used to develop and print ordinary photographs. First, it takes a photograph of the original. The film is then developed by a chemical solution, producing a negative. To make a positive copy, the image on the negative is projected onto positive paper. Finally, the paper is developed to create the copy. A *photostat machine* projects light reflected from the original directly onto light-sensitive paper. Developing the paper produces the copy. The photostat machine, like any other projection copier, can enlarge or reduce the size of the copy made from the original.

Contact copying was first used in the mid-1800's. In this method, the original is placed in contact with light-sensitive negative paper and exposed to light. Next, the negative paper is held against positive paper, and the two papers are fed into a contact-copying machine. There, they pass through a developer, such as ammonia vapor or water. The developer brings out the image on the negative and transfers it to the positive paper (the copy). Blueprints and similar types of duplicates are made using this method (see **Blueprint**). Frank J. Romano

See also **Library** (Photocopying); **Xerox Corporation.**

Copyright refers to a body of exclusive rights that protect the works of authors, artists, computer programmers, and other creative people against copying or unauthorized public performance. Copyright generally extends to original works of literary, dramatic, musical, artistic, or intellectual expression.

The first modern copyright law was adopted by Britain in 1709. In the United States, Congress passed the country's first copyright act in 1790. Most nations have copyright laws that cover works originally produced at home or abroad. In the United States, the Copyright Office of the Library of Congress is primarily responsible for administering copyright law.

Patents and trademarks are distinct from copyrights. A patent can be used to prevent an invention from being made, used, or sold by anyone but the owner of the patent. A trademark is a word, name, or symbol designed to distinguish the products or services of one company from those of another. See **Patent; Trademark.**

Works protected. United States copyright law covers numerous types of original works. Such works may be literary, musical, dramatic, pantomime, *choreographic* (dance), pictorial, graphic, or sculptural. Other categories are motion pictures and other audio-visual works, sound recordings, architectural works, computer programs, designs for computer chips, and certain catalogs, directories, and other collections of data.

Literary works consist of novels, poems, and all works that do not fall into any other category. Musical works include original compositions and arrangements, and any accompanying words. New versions of earlier musical compositions may also be copyrighted.

Dramatic works mainly include plays intended for live performance, and screenplays. The copyright covers music for dramatic productions, such as operas, musical comedies, and musical plays for television.

Pantomimes and choreographic works can be copyrighted if they are filmed or taped, or are written. Choreographic works do not include social dance steps.

Pictorial, graphic, and sculptural works include photographs, holograms, greeting cards, picture postcards, cartoons, comic strips, posters, ceramic figurines, glassware, and decals. Lithographs, etchings, and other art reproductions by the original artist are also covered, as are maps, globes, charts, jewelry, toys, various designs and patterns, and other types of visual arts.

Motion pictures include all works consisting of a series of related images, regardless of whether the images are recorded on film, tape, or disc. Audio-visual works include motion pictures, as well as filmstrips and other works that consist of sequences of images but do not give the impression of motion when shown. Sounds accompanying audio-visual works are also protected.

Two main elements in a sound recording are covered by copyright protection. These elements are the contribution of the performer and the contribution of the people responsible for capturing and processing the sounds in the final recording. Copyright laws also forbid the unauthorized commercial distribution and rental of sound recordings and the unauthorized recording and distribution of a live performance.

Architectural works include buildings and architectural plans and drawings. Copyright law covers the overall form of an architectural work and the unique arrangement of elements and spaces in its design. Anyone who restores an architectural work protected by copyright is entitled to copyright protection in the restored work.

A computer program consists of instructions written for a computer. Computers cannot operate without the programs, which are often called *software*. Copyright law forbids unauthorized distribution or duplication of computer programs. But a purchaser of a program may make and keep one copy for storage purposes.

A computer chip is a tiny piece of material that contains a complex electronic circuit. Computer chips are an essential part of computers and other electronic devices. *Masks* (designs) describe the electronic circuits a chip contains and can be used as stencils to make copies of chips. Such masks can be registered and protected under copyright law.

To be copyrighted, catalogs, directories, and other collections of data must have original content. That is, they must result from some creativity beyond the act of merely listing known data.

Copyright protection applies only to the extent of a person's expression. No protection is available for ideas, concepts, names, titles, short phrases, general themes, or familiar symbols, or for blank diaries, bank checks, and other types of blank forms. Works of the United States government—that is, works authored by a federal employee within the scope of his or her employment—may not be copyrighted.

Owners' rights. A copyright carries with it the exclusive right to reproduce and distribute copies—including sound recordings—of the copyrighted work. But except for sound recordings and computer programs, once a copy has been sold, the purchaser may rent the copy without permission of the copyright owner. All types of copyrighted material may be resold without permission.

A copyright also gives the owner the sole right to prepare works based upon the copyrighted work, such as translations, condensations, and motion-picture versions. In addition, the owner has the exclusive right to perform the work publicly if it is a literary, musical, dramatic, or choreographic work; a pantomime; or a motion picture or other audio-visual creation. The copyright owner has the sole right to display the work publicly if it is a pictorial, graphic, sculptural, literary, musical, dramatic, or choreographic work; a pantomime; or individual images from a motion picture or other audio-visual work. The creators of certain works of visual art have the right to be identified as the work's creator and to protect the integrity of the work.

Owners of a copyright may transfer their copyright to someone else through a written contract. Under the "works made for hire" doctrine, people who create a copyrighted work within the scope of their employment give up the copyright to their employer. However, if the author of the work is an independent contractor, the author has a right to copyright the work if there is no agreement to the contrary.

Authors of copyrighted works may terminate a copyright transfer but must wait at least 35 years. After 35 years from the date of the transfer, the author may serve a notice of termination and record the notice in the Copyright Office. If an author is dead, beneficiaries named in the copyright law may terminate the transfer.

Copyrights secured before 1978 are good for 28 years. During the 28th year, the copyright may be renewed for an additional 47 years. Works created before 1978 that were neither published nor registered with the Copyright Office before that year are protected until 50 years after the author's death, or until Dec. 31, 2002, whichever is longer. Copyrights secured after Jan. 1, 1978, are good until 70 years after the author's death. The copyrights of anonymous works, works written under a pen name, and works created within the scope of employment are good for 95 years from publication or 100 years from creation, whichever is shorter.

A copyright owner whose copyright is violated may file a lawsuit to stop further *infringements* (violations). Copyright infringers may be liable for actual damages and profits or for damages specified by the law. Unintentional infringement is also illegal but may be treated less harshly by the court than intentional infringement. Willfully violating a copyright is a criminal offense.

Users' rights. Copyright law includes a section on "fair use" that allows limited reproduction of copyrighted material for such purposes as critical commentary, news reporting, and educational use. For example, teachers may make a limited number of copies of a copyrighted work for classroom use, provided the copies are brief and not planned in advance. Archives and libraries may make one copy of a copyrighted work, but they may not regularly reproduce single or multiple copies of such a work. Information on the clearance of photocopying rights can be obtained from the Copyright Clearance Center in Salem, Massachusetts.

In some cases, copyrighted works may be used without permission if the user pays a set fee. Such use is covered in copyright law sections dealing with five types of licensing systems. These systems provide for (1) retransmission of broadcast signals by cable television companies, (2) use of musical compositions by record companies, (3) use of recorded music in jukeboxes, (4) noncommercial broadcasting of published musical, pictorial, graphic, and sculptural works, and (5) secondary transmissions of television superstations and network stations for home viewing.

The unlicensed copying of most types of sound recordings may violate copyright laws. However, owners of digital audio recording machines may use the machines to copy recordings onto blank compact discs and blank digital tapes. The law allows the owners to do so

because the manufacturers of the machines and of the blank discs and tapes pay *royalties* (shares of profit) that are distributed to recording companies, music publishers, and songwriters. The law requires that the blank discs and tapes be manufactured in such a way that further copies cannot be made from them. Some taping of broadcast material in the home—for home use only—is also considered fair use.

In the 1990's, many music owners began turning copyrighted sound recordings into computer files, which were sometimes copied or shared over the Internet. In 2000, the music industry sued Napster, a free Internet file-sharing service, for its role in the unauthorized copying of sound recordings. A federal judge ordered Napster to shut down, but Napster appealed the decision. Later that year, Napster announced plans to charge membership fees for its services and to pay royalties to the recordings' composers and performers.

How to obtain a copyright. The author's rights in a work that may be copyrighted begin when the author creates the work and puts it in a definite form. But the author has no enforceable rights until the work is registered with the Copyright Office.

Registration is available for all forms of unpublished and published works. If registration is requested within three months after publication of the work, the author obtains a right not only to actual damages and profits, but also to damages specified by the law and to coverage of attorneys' fees.

Registration is obtained by sending the Copyright Office a completed application form, a registration fee, and one or two copies of the work to be registered. Upon registration of the work, the Copyright Office will issue the applicant a certificate of registration, which may be submitted in federal court as evidence of copyright ownership. Forms, instructions, and general information about copyright can be obtained from the United States Copyright Office, Library of Congress, Washington, DC 20559.

The Copyright Office recommends that a notice of copyright appear on each copy of any published work. This should consist of either the word "Copyright," the abbreviation "Copr.," or the symbol ©, accompanied by the name of the copyright owner or an abbreviation or other designation by which the owner can be recognized. If the work is a printed literary, musical, or dramatic work, the notice should include the year in which the work was first published, such as "© Alex Haley 1976." If the work is a sound recording, the notice should contain the symbol ℗, the year of first publication of the recording, and the name of the copyright owner. For example, " ℗1982 CBS Records."

International copyright. The United States has participated in many international conventions and bilateral agreements covering copyright. These agreements provide U.S. citizens with copyright protection abroad.

The United States was a founder of the Universal Copyright Convention, signed in 1952. A person may obtain copyright protection in every country that has agreed to the convention by publishing his or her work first in one of the countries (or anywhere in the world if the person is a citizen of one of the countries) with the prescribed notice. Each country must then protect the work according to its own laws.

The Brussels Satellite Convention went into effect in the United States in 1985, and the Berne Convention did so in 1989. The Brussels Satellite Convention prohibits the unauthorized retransmission of satellite signals that carry TV programs. The Berne Convention establishes minimum standards of copyright protection that member states must give to literary and artistic works.

The United States has also joined with several American republics in copyright conventions to protect literary property in the Western Hemisphere. The most important of these conventions is the Buenos Aires Convention, signed in 1910. In 1974, the United States joined the Geneva Phonogram Convention. This convention protects sound recordings. David Pressman

See also **Plagiarism**.

Coral is any of a large group of marine animals related to jellyfish and sea anemones. Nearly all coral animals live together in colonies. Most individual corals, called *polyps,* grow less than 1 inch (2.5 centimeters) in diameter. But a small percentage measure as much as 1 foot (30 centimeters). A coral polyp has a cylinder-shaped body. At the top end is a mouth surrounded by tiny tentacles. Depending on the type of coral, the base of the polyp attaches to other living polyps or to the limestone skeletons of dead polyps. Many kinds of corals create limestone formations called *coral reefs.* Coral reefs look like lovely sea gardens because of the many colorful sea animals that live among the corals. For more information on coral reefs, see **Coral reef**.

Coral polyps live together in colonies. *Stony corals* make up the best known group of corals.

Stony corals build coral reefs. In most species, living polyps attach themselves to each other with a flat sheet of tissue that connects to the middle of each body. Half of the coral polyp extends above the sheet and half below. Each polyp builds its limestone skeleton by taking calcium from seawater and then depositing *calcium carbonate* (limestone) around the lower half of its body. As new polyps grow, the limestone formation becomes larger, eventually creating the structure of a coral reef.

Coral polyps feed mainly on tiny swimming animals, such as the *larvae* (young) of many kinds of shellfish. Most reef-building corals cannot live without single-celled algae called *zooxanthellae,* which live in the polyp's own tissue. The polyps use as food some of the waste products released by the algae. Zooxanthellae also help the corals secrete their limestone skeletons. Coral reefs grow only in water with enough light for *photosynthesis* to occur in the algae. Photosynthesis is the process in which an organism converts energy from sunlight into food.

Coral polyps reproduce either from eggs or by *budding.* Small, knoblike growths called *buds* appear on the body of an adult polyp, or on the connecting sheet. These buds grow larger, separate from the parent, and begin to deposit their own limestone in the colony. Budding helps the colony increase its size.

New colonies of coral polyps form when the adult polyps of an old colony produce eggs. The eggs grow into tiny forms that swim away. Then the developing animals settle to the sea bottom and begin to form new colonies by budding.

Various marine animals eat living stony corals. The loss of coral to such animals is usually balanced by the

development of new coral colonies and the growth of old ones. But beginning in the 1960's, large numbers of crown-of-thorns starfish destroyed stony coral colonies on many reefs of the southwest Pacific Ocean. Scientists are trying to determine what has caused this starfish to become so numerous.

Other kinds of corals form internal rather than external skeletons. *Gorgonian corals,* for example, have internal skeletons of a flexible, horny substance. These corals look like bushes, fans, or whips and can have soft yellow, rose, purple, brown, tan, or black coloring. Gorgonian corals, which include *sea fans* and *sea whips,* live in waters around the world.

People use the term *precious corals* for many kinds of corals with internal skeletons, including some gorgonian corals. Precious corals are valued for jewelry. They have a hard *core* (internal skeleton) that can be polished. Polishing brings out beautiful red, rose, or pink colors. Craftworkers carve precious corals into beads and other ornaments. Many of these corals grow in bushlike formations. L. Muscatine

Scientific classification. Corals are in the phylum Cnidaria and the class Anthozoa.

Related articles in *World Book* include:

Atoll
Coral reef
Gem (picture)
Great Barrier Reef
Limestone
Petoskey stone
Sea fan
Seashore

Coral reef is a type of underwater environment shaped by limestone formations. Reef limestone consists largely of a framework of skeletons from marine animals called *corals.* Reefs also contain the remains of other limestone-producing organisms, such as algae and shellfish, as well as sand and other particles. A coral reef is a complex, biologically rich *ecosystem*—that is, a community of living things and their environment. Many of the world's most colorful animals live in coral reefs. Reefs also provide important benefits to people and to the larger environment.

Coral animals produce formations that may resemble branching trees, large domes, small irregular crusts, or tiny organ pipes. They can glow with rich colors, including beautiful shades of green, orange, purple, tan, and yellow. Coral limestone resists damage from waves, and it can grow hundreds of yards or meters thick. Overall, coral reefs range widely in area. Small patch reefs measure only a few square yards or meters, while some interconnected reef systems span hundreds of square miles or kilometers.

Kinds of coral reefs. There are three basic types of coral reefs: (1) *fringing reefs,* (2) *barrier reefs,* and (3) *atolls.* Each type may consist of distinct areas, such as *reef flats* that extend from the shore to the reef crest, and *reef slopes* that slope downward to the ocean floor.

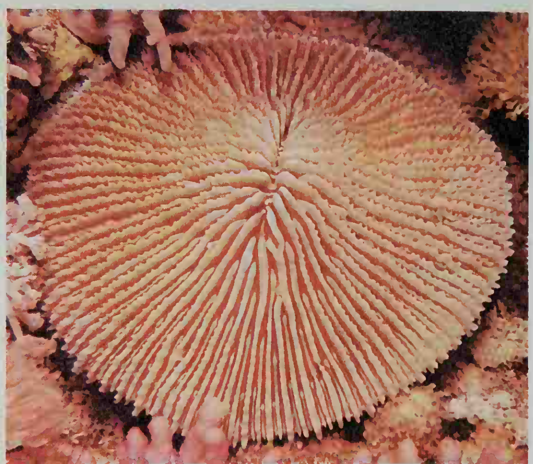
Fringing reefs lie close to shore. Due to their generally smaller size, fringing reefs usually are younger than barrier reefs or atoll reefs.

Barrier reefs also follow the contours of the shore, but they occur farther from the coast than do fringing reefs. Barrier reefs form a barrier between a body of water near the shore, called a *lagoon,* and the open sea. Such habitats may consist of one fairly continuous reef, or they may contain a series of reefs separated by open water channels. Some barrier reefs grow to a considerable size. Australia's Great Barrier Reef ranks as the



Douglas Faulkner

Sea fan corals



Douglas Faulkner

Mushroom corals



Douglas Faulkner

Reef-building corals



© Doug Perrine, Innerspace Visions

A coral reef glows with beautiful colors. These colors come from the coral animals that make up most of the reef's structure, as well as from fish and other wildlife that inhabit the reef. The coral in this photograph from Australia's Great Barrier Reef resemble branching trees and other shapes.

largest group of coral reefs in the world, measuring about 1,400 miles (2,300 kilometers) long.

Atolls are ring-shaped reefs that often create coral islands in the open sea. An atoll forms as an old waterbound volcano slowly sinks into the sea, or the sea level rises around it. The reef grows upward from the surface of the volcano's rim and creates a large ring that surrounds a lagoon. One or more channels connect the lagoon to the open sea. Many coral islands of the South Pacific Ocean are atolls.

Where coral reefs exist. Coral reefs lie mainly in shallow tropical or subtropical seas. Most reef-forming corals cannot live in water colder than 61 to 68 °F (16 to 20 °C). Reefs require enough sunlight to support *photosynthesis* in their algae and plants. Photosynthesis is the process in which organisms use energy from sunlight to make food.

Coral reefs occur throughout warm waters of the Pacific Ocean, in coastal waters of Southeast Asia, in the Indian Ocean as far north as Sri Lanka, around Madagascar on the southeast African coast, and in the Red Sea. They also form along the tropical eastern coast of Brazil, in the Caribbean Sea, and along the coasts of Florida and Bermuda. Though coral reefs do not form in colder seas, certain corals live as far north as the Arctic Circle.

How coral reefs form. Most reef-building coral animals, also known as *stony corals,* live together in colonies. A single member of the colony, called a *polyp,* has a cylinder-shaped body. Its mouth lies at the top of the body, and tiny tentacles surround the mouth. Most polyps grow less than 1 inch (2.5 centimeters) in diameter. The polyps remove calcium carbonate from ocean water and use this material to form their cup-shaped outer skeletons. Coral skeletons accumulate over time in layers to help create a reef. Living corals inhabit the surface layer, while lower layers contain the skeletons of dead coral colonies.

Algae and other organisms also help build coral reefs. Some algae may deposit limestone that cements fragments of coral and other sediment into spaces in the reef framework. This limestone, therefore, serves as glue that holds the reef together. In some reefs, *coralline algae* produce a large portion of the reef structure. The shells or skeletons of clams, snails, sea urchins, and other creatures also provide building materials for reefs.

Coral reefs generally grow less than about 5 inches (13 centimeters) per year and can continue to grow over long periods. The Great Barrier Reef took about 600,000 years to reach its present size.

Life on coral reefs. Tens of thousands of living species inhabit reef areas, including at least 800 species of stony corals. Next to rain forests, coral reefs contain more living species than any other type of ecosystem. Indeed, coral reefs often are called the "rain forests of the oceans."

Reefs usually occur in waters low in *nutrients* (nourishing substances). But reef inhabitants overcome this problem by efficiently recycling nutrients. The waste products of many reef organisms become food for other organisms. Nutrients repeatedly cycle through organisms, decreasing the need for new nutrient sources.

Vast numbers of colorful fish inhabit coral reefs. Many have special adaptations for reef environments. Parrotfish possess beaklike front teeth that they use to scrape

off algae, their main food, from the hard corals. Moray eels have long, thin bodies that enable them to hide in limestone cracks, from which they catch passing prey. Reefs also provide homes for reptiles. Sea turtles have paddlelike flippers for swimming. Sea snakes rank among the world's most poisonous animals. In addition, coral reefs house a huge variety of *invertebrates* (animals without backbones), including clams, crabs, lobsters, octopuses, sea anemones, sea stars, and sponges.

Unusual plants called sea grasses grow in many reef areas. They resemble true grasses but are not closely related to them. Unlike most plants, sea grasses can survive completely underwater. But they need to receive enough sunlight for photosynthesis to occur. Sea grasses provide food for a variety of reef animals.

Numerous microscopic organisms also play important roles in coral reefs. One common group, the *bryozoans,* encrust reefs and help cement their structures.

Many reef dwellers have special relationships with one another. For example, the tissues of most reef corals contain tiny *zooxanthellae,* a group of single-celled algae. Coral polyps consume certain waste products released by the algae, and the algae use as nutrients some of the polyps' waste. Zooxanthellae also speed the process by which the corals produce their limestone skeletons. Such *symbiotic* relationships play an important role in reef life. In *symbiosis,* different organisms live together in a manner that benefits one or more of them.

Many other reef creatures have symbiotic relationships with one another. For instance, the tentacles of sea anemones provide refuge for anemonefish. The anemonefish, in turn, may lure prey toward the anemone or feed it scraps of food. Colorful, cigar-shaped fish called wrasses feed on parasites from the bodies of larger fish, and thus help keep the larger fish clean.

Coral reefs and the environment. Coral reefs provide a number of vital benefits to the world's environment. They contribute to *biodiversity,* or the planet's variety of life forms, by providing homes for many different animals and plants. They also protect coastlines from erosion by strong ocean waves and can even produce the sand that makes up beaches.

Some scientists believe that coral reefs help regulate the planet's temperature. The processes by which many reef creatures produce their shells causes them to absorb carbon dioxide, a gas that can raise the earth's temperature if too much of it enters the atmosphere. Thus these reef creatures may help keep the planet from becoming too warm. However, coral reefs also produce carbon dioxide, so scientists continue to study how coral reefs affect global climate change.

Coral reefs and people. Reefs aid people in numerous ways. Many societies depend on reef animals for food. Coral reefs also benefit the economies of some nations by drawing large numbers of tourists. In medicine, doctors use coral limestone to replace parts of human bones, and medical researchers believe chemicals from certain reef organisms may help them discover new medicines.

Despite the benefits coral reefs provide, human activities have led to the destruction of many reef environments. The fishing industry poses numerous threats to reefs. Fishing methods using dynamite, cyanide, or bleach can destroy coral life. Overfishing may upset reef stability by endangering certain reef species. Ships passing too close to reefs can hit and damage them.

The widespread burning of fossil fuels also damages reefs. Such pollution produces large amounts of carbon dioxide in the atmosphere. Excess carbon dioxide contributes to global warming, and thus to a rise in ocean temperatures. High water temperatures can cause corals to *bleach* and die. Bleaching occurs when corals become stressed and their zooxanthellae die or are expelled from the polyps.

Many other human activities harm coral reefs. *Deforestation* (cutting down forests) causes soil to wash into the sea and block out sunlight that corals need to survive. Agricultural fertilizers seep into oceans and promote the overgrowth of algae that smother polyps. The development of seaside homes and hotels may cause pollution that poisons corals.

Proper reef management can help to protect coral reefs from some of the most harmful human activities. Moreover, many governments and conservation organizations are working to preserve these important ecosystems. Richard E. Dodge

Related articles in *World Book* include:

Atoll	Fish (pictures)
Australia (picture)	Great Barrier Reef
Coral	Island (Coral islands; pictures)

Coral Sea, *KAWR uhl,* is the part of the Pacific Ocean between the northeast coast of Australia, the Solomon Islands, and the Vanuatu island group. It has an unusually large number of coral atolls and bank reefs. The boundaries of this sea are so indefinite that the name could be applied to large parts of the Southern Pacific. The reefs along the western shores of the Coral Sea have the finest specimens of coral (see **Coral reef**).

United States and Japanese naval forces fought a key World War II battle in the Coral Sea in May 1942. Neither side won a clear-cut victory, but the Japanese offensive was checked for the first time in the war. D. N. Jeans

See also **Pacific Islands** (map).

Coral snake is the name given to several closely related poisonous snakes of the Western Hemisphere. They are found in the southern United States, Mexico, Central America, and tropical South America. They have small, blunt heads and brightly colored bodies.

Coral snakes are extremely poisonous. They do not strike as effectively as other venomous snakes, but they bite. They are dangerous if stepped on or handled. They are snake eaters.

The *eastern* coral snake generally ranges from 20 to 40 inches (51 to 100 centimeters) in length. It lives in the southeastern United States and in extreme northeastern Mexico. Its body is encircled by broad black and red bands separated by narrow yellow ones. Just behind the snake's black snout is a wide yellow band followed by a black band. Some of these coral snakes are covered with black pigment that hides much of the red color. Some nonpoisonous snakes look like these coral snakes because they have similar coloring. But the coral snakes have red bands next to yellow ones. The harmless snakes have red bands next to black ones.

The *western,* or *Arizona,* coral snake is about 18 inches (46 centimeters) long. It lives in the lower parts of southern Arizona, in southwestern New Mexico, and in northern Mexico. It also has a black snout. Behind the



WORLD BOOK illustration by John F. Eggert

A South American coral snake grows about 4 feet (1.2 meters) long. The individual shown in this illustration has black, red, and white bands. Coral snakes are extremely poisonous.

snout is a white or yellow band followed by a red band.

The *South American coral snake* is about 4 feet (1.2 meters) long. It is common in tropical South America. Its body is encircled by bands of bright red separated by broad bands of black. Within each black band are two narrow bands of white or yellow. The white or yellow bands do not touch the red bands, a characteristic that distinguishes this snake from North American coral snakes. The scales of the snake are shiny and polished.

Scientific classification. Coral snakes belong to the family, Elapidae. The scientific name for the eastern coral snake is *Micrurus fulvius.* The western, or Arizona, is *Micruroides euryxanthus,* and the South American coral snake is *Micrurus lemniscatus.* D. Bruce Means

See also **Snake** (picture: Some poisonous snakes of North America).

Coral tree, also known as *coralbean,* is the name of more than 100 species of trees and shrubs that grow in tropical and nearly tropical regions throughout the world. They are widely cultivated as shade trees and as ornamentals. Most coral trees are *deciduous*—that is, they lose their leaves and grow new ones each year.



Field Museum of Natural History

A coral tree bears large, brightly colored flowers.

Coral trees have compound leaves made up of three leaflets. Many species have thorns along the branches and even on the *petioles* (stems) of the leaves. Most coral trees bear large, showy flowers that are red or orange. Birds pollinate the flowers. In the Americas, coral trees are chiefly pollinated by hummingbirds.

The red and black seeds of many species of coral trees are used for necklaces and other jewelry. However, the seeds commonly contain substances that are poisonous if eaten. Local peoples extract some of these substances for use in medicines.

Scientific classification. Coral trees make up the genus *Erythrina* in the pea family, Fabaceae or Leguminosae.

Philip W. Rundel

Corbett, James John (1866-1933), became the world heavyweight boxing champion in 1892. He was regarded as one of the first scientific boxers. A bank teller, Corbett had his first professional bout in 1884, and won the heavyweight title from John L. Sullivan in 1892. He lost it to Bob Fitzsimmons in 1897. After trying twice to regain the championship, he retired from the ring and pursued a career as an actor. Corbett was born in San Francisco. He became known as "Gentleman Jim" for his fancy style of dress. Bert Randolph Sugar

Corbin, Margaret Cochran (1751-1800), became a heroine at the Battle of Fort Washington in 1776, during the Revolutionary War in America (1775-1783). She was born in Franklin County, Pennsylvania. In 1756, Indians killed her father and captured her mother. An uncle raised her.

In 1775, Margaret's husband, John Corbin, enlisted in the Continental Army, and he served as a gunner in the Revolutionary War. Like many other soldiers' wives at the time, Margaret joined her husband in camp to cook, wash, and do other chores for the troops. At Fort Washington, on the site of present-day New York City, John Corbin was killed. Margaret replaced him at his cannon and fought until she was seriously wounded.

Corbin's wounds left her disabled. In 1779, the Continental Congress awarded her a military pension, making her one of the first women in the United States to receive such aid. Corbin is buried in the military cemetery at West Point, N.Y. William Morgan Fowler, Jr.

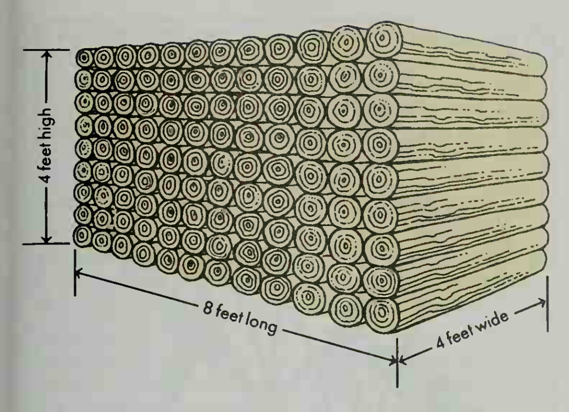
Corbusier. See **Le Corbusier.**

Corcoran Gallery of Art, in Washington, D.C., has collections of paintings, sculpture, drawings, tapestries, photographs, and ceramics. It houses one of the world's most important collections of American art and displays works by Josef Albers, Thomas Cole, Mark Rothko, Gilbert Stuart, John Singer Sargent, Winslow Homer, and Thomas Sully, among others. The W. A. Clark Collection is devoted to masterpieces from Europe. The gallery also organizes exhibitions, one of the most important being the Biennial Exhibition of Contemporary American Painting. An art school operated by the gallery offers a Bachelor of Fine Arts degree as well as an open program of nondegree courses.

William Wilson Corcoran, a banker and philanthropist, founded the gallery in 1869. The Corcoran Gallery of Art is a self-supporting institution.

Critically reviewed by the Corcoran Gallery of Art

Cord is a unit for measuring firewood. A cord has a volume of 128 cubic feet (3.6 cubic meters). Any set of numbers totaling 128 cubic feet would be a cord. For exam-



A cord of wood is 128 cubic feet (3.6 cubic meters).

ple, a pile of wood 4 feet (1.22 meters) wide, 4 feet high, and 8 feet (2.44 meters) long would represent a cord (4 feet × 4 feet × 8 feet = 128 cubic feet). The cord is not recognized as a legal measure by the United States government. Leland F. Webb

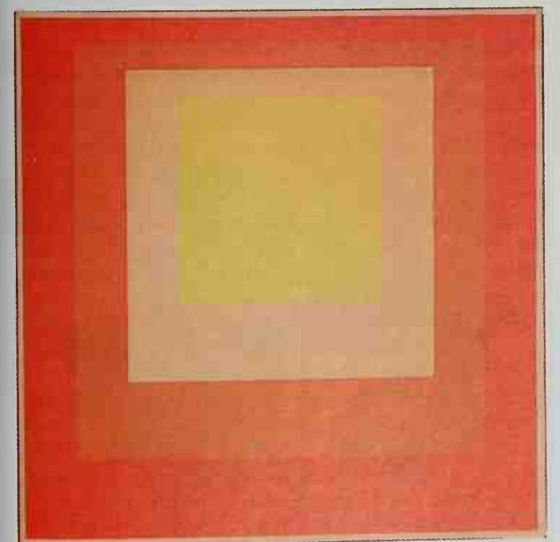
Corday, *kawr DAY,* **Charlotte** (1768-1793), a French patriot, killed Jean-Paul Marat, a radical leader of the French Revolution, during the Reign of Terror in 1793. She was tried in a Revolutionary court, and, four days later, she was guillotined. She sympathized with the Girondists, a group of representatives in the French legislature (see **Girondists**). When the Girondist leaders were arrested, Corday resolved to kill Marat, an opponent in the legislature. She obtained an interview with him. While he was in his bath, where he spent several hours each day seeking relief from a skin disease, she stabbed him to death. Charlotte Corday was born in Normandy, France.


Culver

Charlotte Corday

Richard M. Brace

See also Marat, Jean-Paul.


Casein painting on Masonite (1956); Corcoran Gallery of Art, William A. Clark Fund

The Corcoran Gallery collection includes works by Josef Albers and other major American artists. One of the Albers paintings on display is his abstract work *Homage to the Square: Yes.*

Cordial. See Alcoholic beverage (Liqueurs).

Cordillera, *KAWR duhl YAIR uh* or *kawr DIHL uhr uh,* is a group of mountain ranges, usually the principal mountain group of a continent. The word *cordillera* comes from a Spanish word meaning *cord* or *chain.* Spaniards use the word to mean any mountain chain. The term *cordillera* once was used in America to mean only the Andes Mountains. American geographers now use the term to mean any group of mountain systems, such as the western cordillera of North America, which includes the Sierra Madre, the Rockies, the Sierra Nevada, the Cascade Range, the Coast Ranges, and the Great Basin ranges. South America, Asia, and Europe also have cordilleras. Richard G. Reider

Cordite, *KAWR dyt,* was one of the original smokeless powders used to propel projectiles from guns. The name *cordite* refers to the cordlike lengths in which it was made. Cordite is composed of 30 percent nitroglycerin, 65 percent nitrocellulose, and 5 percent petrolatum. The British government patented the cordite formula in 1889. This cordite burned with so much heat it damaged gun barrels. James E. Kennedy

Córdoba, *KAWR duh buh* (pop. 1,179,372), is the second largest city in Argentina. Only Buenos Aires, the capital, has more people. Córdoba is a major industrial center and the capital of the Argentine province of Córdoba. The city lies in northern Argentina, at the base of a mountain range called the Sierra de Córdoba. For the location of Córdoba, see **Argentina** (political map).

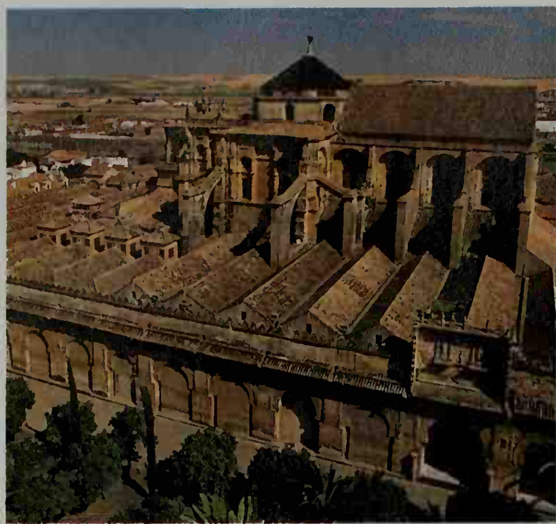
Córdoba ranks as Argentina's top producer of automobiles and tractors. The city is also a leading manufacturer of textiles and of glass and leather products. Despite its industrialization, Córdoba has preserved many traditional features, including old churches, public squares, and promenades. The oldest university in Argentina, the National University of Córdoba, was established in 1613.

Córdoba was founded in 1573 by Spaniards who had come to the area from Chile. Its location on early trade routes to Chile and Peru, along with rich agricultural land surrounding the city, helped Córdoba grow and prosper. Richard W. Wilkie

Córdoba, *KAWR duh buh* (pop. 300,229), is an ancient Moorish city in Spain, and the capital of Córdoba province. The city lies 86 miles (138 kilometers) northeast of Seville. For the location of Córdoba, see Spain (political map).

Romans occupied Córdoba in 206 B.C. The city reached its peak of importance in the A.D. 900's as a famous center of Moorish art and culture. The cathedral in Córdoba is the city's chief landmark. It was built as a *mosque* (Muslim house of worship) in the 700's and was made into a Roman Catholic cathedral in 1238. More than 1,000 pillars of granite, onyx, marble, and jasper support its arches.

Córdoba is the home of soft, fine-grained cordovan



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The cathedral in Córdoba, Spain, *shown here,* is the city's chief landmark. It was built as a Muslim house of worship in the 700's and became a Roman Catholic cathedral in 1238.

leather. Nearby farms produce cereals, grapes, olives, and vegetables. Stanley G. Payne

Corduroy, *KAWR duh roy,* is a cotton or cotton blend fabric with raised ribs of the cloth running lengthwise. The name probably comes from the French phrase *cord du roi,* meaning *king's cord.* Corduroy with wide ribs is called *wide-wale corduroy.* The type with narrow ribs is called *pin-wale corduroy.* Corduroy is made 54 inches (137 centimeters) wide for clothing, draperies, and upholstery. It may be in one color or a variety of printed patterns. Christine W. Jarvis

Core, in geology. See **Earth** (Earth's spheres).

CORE. See Congress of **Racial Equality**.

Corelli, *koh REHL ee,* **Arcangelo,** *ahr KAHN jeh LAW* (1653-1713), was one of the earliest major violinists and composers of violin music. Corelli's compositions became models for both solo and ensemble music for the violin. He developed the *concerto grosso,* which combines a large instrumental group with a trio that usually consists of two violins and a cello. Corelli also wrote violin sonatas in four *movements* (sections), which became a standard form for later sonata compositions. Corelli's works were published in six collections. Each of the first five collections consists of 12 sonatas. The sixth is a collection of 12 concerti grossi.

Corelli was born in Fusignano, near Imola, in Italy. He studied violin as a teen-ager at the Accademia Filarmonica in Bologna, but he spent most of his adult life in Rome. He gained a reputation as an excellent musician and conductor and was popular in Roman social circles. For many years, he directed an important series of concerts at the palace of his friend and patron, Cardinal Pietro Ottoboni. Joscelyn Godwin

Coreopsis, *KAWR ee AHP sihs,* is a large group of plants related to the sunflower. They are commonly called *tickseeds.* The plants may be from 1 $\frac{1}{2}$ to 4 feet (46 to 120 centimeters) high. Their yellow, red, or maroon flowers look like daisies and grow on slender stems. The flat fruits are small and dry and look like bugs. *Core-opsis* is the Greek word for *bug.* Most coreopsis plants are perennials and live for several years. But some are annuals and live only one season. A common annual coreopsis is often called *calliopsis.* Gardeners cultivate perennial and annual coreopsis plants. David E. Zimmer



WORLD BOOK illustration by Lorraine Epstein

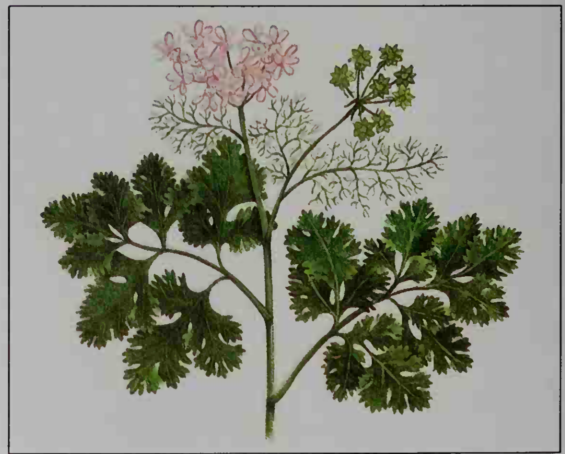
Flowers of the coreopsis plant look like daisies and grow on slender stems. Coreopsis plants grow as high as 4 feet (120 centimeters). They are commonly called *tickseeds.*

Scientific classification. Coreopsis plants form the genus *Coreopsis* in the composite family, Compositae. The scientific name for the calliopsis is *C. calliopsidea.*

See also **Flower** (picture: Flowers of prairies and dry plains [Tickseed]).

Corgi. See **Cardigan Welsh corgi; Pembroke Welsh corgi.**

Coriander, *KAWR ee AN duhr,* is an herb that grows in the countries around the Mediterranean Sea. The plant is about 3 feet (91 centimeters) high and has small white flowers. Its seeds have a pleasant odor when ripe, and they taste sweet after they have been dried out. The seeds are used as a spice in curries, sauces, and liqueurs, and to make small round candies. They are used



WORLD BOOK illustration by Lorraine Epstein

Coriander is an herb that grows in the Mediterranean region. People use the plant's sweet-tasting seeds as a spice in curries, sauces, and other foods.

in Europe more than in the United States or Canada. But the United States usually imports about 1,400,000 pounds (635,000 kilograms) of coriander seeds a year. Coriander-seed oil is used to flavor food, and as a medicine. About 500 pounds (230 kilograms) of seeds yield 5 pounds (2.3 kilograms) of oil. Lyle E. Craker

Scientific classification. Coriander belongs to the parsley family, Apiaceae or Umbelliferae. Its scientific name is *Coriandrum sativum.*

Corinth, *KAWR ihnth,* was an important city of ancient Greece. It was founded in prehistoric times on the isthmus that connects the Peloponnesus with the rest of Europe. For the location of Corinth, see **Greece, Ancient** (map). According to Homer, it was the home of the legendary characters Bellerophon, Medea, and Sisyphus.

Corinth was favorably situated for trade by land. It also had good harbors at Cenchreae and Lechaeum, on either side of the isthmus. By 750 B.C., Corinth had become the wealthiest city of ancient Greece. Except for two periods (454-404 B.C. and 146-44 B.C.), it maintained economic supremacy for about 1,300 years.



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Roman ruins stand in Corinth, an important city of ancient Greece. The Romans destroyed the city in 146 B.C., but they later rebuilt it.

In 734 B.C., Corinthians founded colonies at Corcyra (now Corfu), an Ionian island west of Greece, and at Syracuse in Sicily. In 581 B.C., they instituted the Isthmian Games, a national festival held every second year in honor of their principal god, Poseidon. Corinth was famous for its skilled workers in bronze and clay and for its naval architects. Because of commercial and political rivalry with Athens, Corinth was chief instigator of the Peloponnesian War (see **Peloponnesian War**).

The Romans destroyed the city in 146 B.C. but later rebuilt it by order of Julius Caesar. Emperor Augustus made it capital of the Roman province of Achaea. Saint Paul visited Corinth in A.D. 51 and founded a church there (see **Corinthians, Epistles to the**).

In the Middle Ages, the city was largely confined to its citadel, Acrocorinth. American archaeologists began excavations in Corinth in 1896. Ronald P. Legon

Corinth Canal, *KAWR ihnth,* provides a waterway between the Gulf of Corinth and the Saronic Gulf in east-central Greece. The canal is 4 miles (6 kilometers) long. It cuts through the narrow strip of land that connects the peninsula of Peloponnesus with the rest of the Greek mainland. A French company began building the canal in 1881, and Greece finished it in 1893. An attempt to build such a canal had been made by the Roman Emperor Nero in A.D. 67. John J. Baxevanis

Corinthians, *kuh RIHN thee uhnz,* **Epistles to the,** are the seventh and eighth books of the New Testament. They are letters from the apostle Paul to members of the Christian church he had established in Corinth, Greece.

Paul wrote the first letter from Ephesus, in what is now Turkey, about A.D. 54. In the first half of the letter, he discussed problems that were reported to him orally, especially the problem of divisions within the church. In the rest of the letter, Paul discussed questions that the Corinthians raised in a letter they wrote to Paul.

Many scholars doubt that Paul wrote Second Corinthians in the form in which we know it. They think that it consists of several shorter letters from Paul to the Corinthians that a later editor combined. Whether or not this is so, Second Corinthians is mainly intended to repair the relationship between Paul and the Corinthians. Soon after Paul wrote his first letter, the Corinthians began to transfer loyalty to other apostles who had arrived in Corinth and seemed superior to Paul. The Corinthians questioned Paul's authority and sincerity. He wrote Second Corinthians to persuade them to accept him as they had done in the past. Terrance D. Callan

See also **Paul, Saint; Bible** (Books of the New Testament).

Coriolanus, *KAWR ee uh LAY nuhs,* **Gaius Marcius,** *GAY uhs MAHR shee uhs,* was a general of the early Roman Republic. He was given his last name as a reward for his skill and bravery in capturing the town of Corioli from the Volscians, who were bitter enemies of Rome.

During a famine in 491 B.C., Coriolanus suggested that no grain be given to the poor unless they gave up their right to elect *tribunes* (representatives). The people resented his proposal and exiled him. Coriolanus joined the Volscians to get revenge and led their army to Rome's gates. He was about to capture Rome when his mother and wife persuaded him to spare it. The angry Volscians then killed him. William Shakespeare told this warrior's story in the tragedy *Coriolanus.* Arther Ferrill

See also **Shakespeare, William** *(Coriolanus).*

Coriolis effect, *KAWR ee OH lihs,* is the apparent effect of the earth's rotation on the motion of anything traveling across the face of the globe. The Coriolis effect is too small to be noticeable when a person walks or drives. But it greatly affects the paths of objects flying over the earth. For example, a missile traveling above the earth tends to move in a straight line. But, to an observer rotating along with the earth, the path of the missile appears to curve, as if it were pushed. This apparent push is the Coriolis effect. The Coriolis effect prevents winds from the North and South poles and the equator from moving directly north or south. Winds that blow toward the equator seem to curve toward the west. Winds that move away from the equator seem to curve to the east. The Coriolis effect also influences the direction of ocean currents. The Coriolis effect is named for Gaspard Gustave de Coriolis, the French scientist who described it in 1835. See also **Air** (Air movement); **Weather** (Planetary-scale systems). James C. G. Walker

Cork (pop. 133,271) is the second largest city of the Republic of Ireland. Only Dublin, the capital, has more people. Cork is also the Irish Republic's second most important city—after Dublin—in such activities as manufacturing and trade and in education, medicine, and other services. Cork lies in southern Ireland, at the northwest end of Cork Harbour. For location, see **Ireland** (map). The central part of the city is on an island between two branches of the River Lee. The rest of Cork spreads over hilly land north and south of the river.

Cork's location on an island and hills gives the city a picturesque appearance. Cork has several beautiful churches, including St. Mary's Cathedral and St. Finbar's Cathedral. University College is in the city.

Cork is an exporting and importing center. Goods manufactured in the Cork area include alcoholic beverages and processed foods, chemicals, electronics products, petroleum products, steel, and textiles.

Vikings established Cork in the 800's, though a small settlement had previously been on the site. Cork grew rapidly during the 1700's, when its merchants established industries that processed agricultural products and handled goods being exported and imported. At that time, the originally swampy island was drained and became the core of the city. Cork later grew to include higher land north and south of the island. Cobh, a town near Cork, became the main port of departure for Irish emigrants sailing to North America in the 1800's.

Desmond A. Gillmor

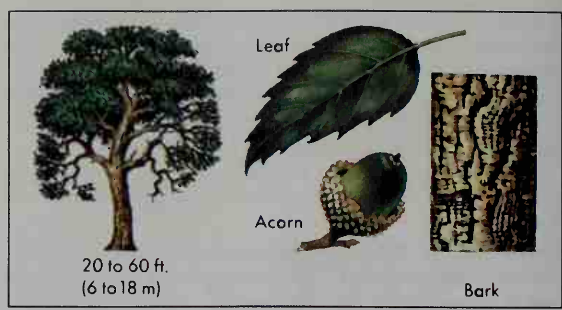
Cork is a lightweight, spongy substance obtained from the bark of the cork oak tree. It does not absorb water readily and can be compressed a great deal, but it springs back when released. People used cork as early as 400 B.C. The Romans wore cork sandals and used cork to float anchors and fishing nets. Cork bottle stoppers have been made since the 1600's.

The tree. The cork tree is a live oak. This means that it is green the year round. It grows abundantly in Portugal and Spain, where most of the world's cork is produced. Italy is the third most important country in cork production. The cork oak has been planted in parts of California, and in some of the southeastern states, but the total yield of cork there is small. The outer layer of the bark is dead and is separated from the live inner bark by a layer of water-resistant cells called the *phelloderm.* These cells have thin walls that become thickened and waxy. The cork tree lives from 300 to 400 years, but it seldom grows more than 50 feet (15 meters) high.



© Odyssey Productions

Cork comes from the bark of the cork oak tree. Workers remove the bark and let it dry in the sun. Cork is used for wall coverings, bulletin boards, and many other products.



WORLD BOOK illustration by Chris Skilton

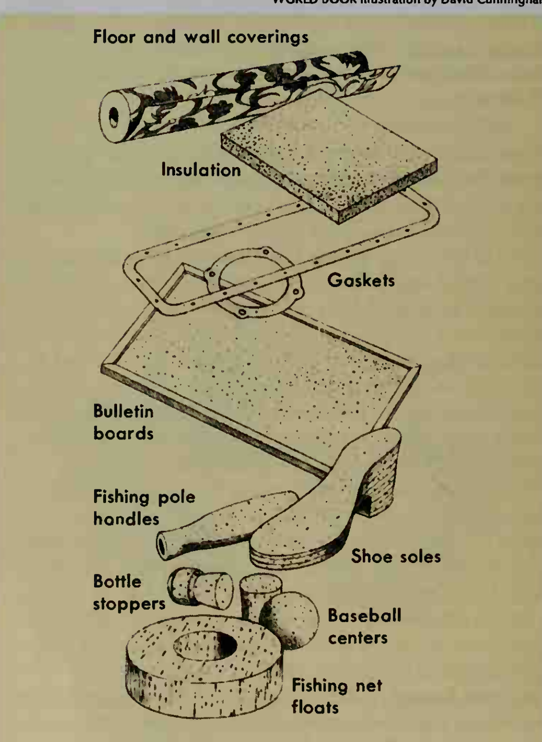
The cork oak tree provides most of the world's supply of cork. The cork is made from the tree's bark. The bark is stripped away every 8 to 10 years without damaging the tree.

Gathering cork. A cork tree must be about 20 years old before its bark is thick enough to be stripped. The first layer removed is called *virgin bark.* Workers strip the bark in June, July, and August. Each tree can be stripped about once every 8 to 10 years. The best cork comes after the tree has been stripped twice.

A cork stripper uses a long-handled hatchet to cut long, oblong sections of bark from the top of the lowest branches to the bottom of the tree. The sections of bark are pried off carefully with the wedge-shaped handle of the hatchet. New phelloderms continue to form so that more cork is produced after each stripping. Cork will

Some uses of cork

WORLD BOOK illustration by David Cunningham



never grow again on a spot where the stripper's hatchet has damaged the live inner layer of bark down to the *cambium.* Cells in this tissue divide to form new layers of wood and bark cells.

Preparation for market. The slabs of stripped cork are boiled, and a rough, gritty outer layer is scraped off. The boiling dissolves tannic acid from cork, and softens the material so that the slabs can be straightened out. The slabs are then dried and packed in bundles. Before being loaded on ships, cork is sorted according to quality and thickness.

Uses. Most cork is used for insulation. For this purpose, it is ground and pressed into boards and pipe coverings. In this form, cork covers the walls and freezing pipes of thousands of cold-storage plants, meat-packing factories, ice cream plants, and oil refineries. Cork floats in water and is used in making buoys and floats for fishing nets. Linoleum is made by mixing cork powder with linseed oil and spreading this paste over canvas or burlap. Floors, walls, and ceilings are made soundproof with corkboard. One of its principal uses is for "corks," or bottle stoppers. Thin cork gaskets seal metal bottle caps. In addition, cork is used in waterproof coatings, in balloon fabric, and as wadding for shotgun cartridges. Cork shavings are burned to make *Spanish black,* or *cork black,* which is a paint used by artists.

Scientific classification. The cork oak tree is in the beech family, Fagaceae. It is *Quercus suber.* Peter S. Ashton

See also **Bark; Insulation; Oak; Tree** (The parts of a tree).

Corliss, George Henry (1817-1888), an American engineer, helped improve the steam engine. His refinements included a more reliable *governor,* a device that held the engine's speed steady by controlling the supply of steam. His improved engine helped the textile industry. The speed was so steady that machines driven by the engine had less of a tendency to break fine threads. For the Philadelphia Exposition of 1876, Corliss designed a larger engine than any that had ever been built. Corliss was born in Easton, N.Y. David F. Channell

Corm is a short, thick underground stem. The main function of a corm is food storage. During the growing season, the corm stores food made by the plant's leaves. At the end of the growing season, the aboveground parts of the plant usually die, but the corm stays alive. The next spring, new aboveground stems and leaves are formed, using the food that the corm has stored all winter. A new corm then develops above the old one, and the old corm dies. The new corm continues to grow as it, in turn, stores food.

Tiny corms, called *cormels,* grow out of the main corm. Gardeners separate the cormels from the corm and plant them. The cormels then grow into new plants.

Corms resemble bulbs in size and shape, but their internal structure is different. Bulbs consist mainly of fleshy leaves, but a corm is mostly stem tissue, covered by thin leaves. Gladiolus and crocus are well-known plants with corms. Richard C. Keating

See also **Bulb; Stem.**

Cormorant, *KAWR muhr uhnt,* is a large, web-footed bird that catches fish by diving underwater. Cormorants are found throughout the world. Most of them live on seacoasts, but they are often seen on large rivers and lakes. Cormorants are related to pelicans. There are about 30 species of cormorants. The large species measure more than 30 inches (76 centimeters) long. Cormorants have long, powerful, hooked bills. Most species are strong fliers, and all are excellent swimmers.



WORLD BOOK illustration by John Rignall, Linden Artists, Ltd.

Double-crested cormorant

A common cormorant of North America, the *double-crested cormorant,* perches in trees, on rocks, and on the ledges of sea cliffs. Hundreds of these birds live around the Bay of Fundy in Nova Scotia and New Brunswick. With their feathered bodies, long necks, and flat heads, they look like rows of bottles sitting on the cliffs. The double-crested cormorant has greenish-black, bronze-tinted feathers. During the nesting season, it has a crest of curved white feathers behind each eye. It has an orange throat. The *great cormorant* is larger than the double-crested cormorant and has white feathers bordering the throat. It lives along the Atlantic Coast of North America and coastal areas throughout Europe.

Cormorants look for fish while swimming on the water's surface. When they spot a fish, the birds dive below the surface and swim underwater with powerful kicks of their webbed feet. Cormorants usually return to the surface to eat their catch.

Scientific classification. Cormorants belong to the cormorant family, Phalacrocoracidae. The scientific name for the double-crested cormorant is *Phalacrocorax auritus.* The great cormorant is *P. carbo.* James J. Dinsmore

See also **Pelican.**



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The cormorant dives into the water to catch fish and returns to the surface to eat them. This photo shows a double-crested cormorant about to swallow a gar in the Florida Everglades.



Larry Lefever from Grant Heilman

Rows of corn cover much of the farmland in a region of the Midwestern United States called the Corn Belt. Corn is one of the world's most important crops. It is a leading source of energy in the human diet, serves as a major livestock feed, and has many industrial applications.

Corn

Corn, also called *maize,* is a plant whose food value and wide variety of uses make it one of the world's most important crops. Corn and two other grains, rice and wheat, provide the chief sources of energy in the human diet.

Corn has a remarkable number of uses. The *kernels*—that is, the corn grain, or seeds—can simply be cooked and eaten. The kernels can also provide ingredients for making breakfast cereals, baked goods, salad dressing, and many other foods. Farmers use large quantities of corn grain, as well as cornstalks and other parts of corn plants, to feed to livestock. People eat this corn indirectly in the form of meat, eggs, and dairy products. In addition, manufacturers use corn in making many kinds of nonfood products, including ceramics, drugs, paints, paper goods, and textiles.

Corn is a cereal grass distantly related to wheat, rice, oats, and barley. American Indians living in what is now Mexico learned how to grow corn thousands of years ago. Thus, corn came to be called *Indian corn.* But today the term generally refers only to varieties of corn that produce ears with multicolored kernels.

Depending on the variety, corn can grow in most mild and tropical regions. The United States ranks as the world's leading producer and exporter of corn. It produces about two-fifths of the world's supply, chiefly in a region of the Midwest called the Corn Belt. Other major corn producers include Argentina, Brazil, China, France, Mexico, and Romania.

Ricardo J. Salvador, the contributor of this article, is Associate Professor of Agronomy at Iowa State University.

Uses of corn

Food for people. Corn grain provides an especially rich source of starch. Starch is a *carbohydrate,* a nourishing substance in food that gives the body energy. Corn also supplies fats and protein. But corn protein lacks some of the important chemical units called *amino acids* that the body needs. In many developing countries in Latin America, Africa, and Asia, corn forms a major part of the human diet. Therefore, a large number of people in those countries can suffer from protein malnutrition if an alternative protein source is not available. Scientists working in Mexico have developed *quality protein maize* for these populations. This type of modified corn has higher levels of protein.

People can eat corn in several ways. Many enjoy eating sweet corn on the cob after the ears have been boiled or roasted. Sweet corn kernels that have been removed from the cob are sold canned or frozen for easy preparation. Popcorn ranks as a favorite snack food. People eat it plain or flavored with such foods and seasonings as salt, butter, caramel, or cheese.

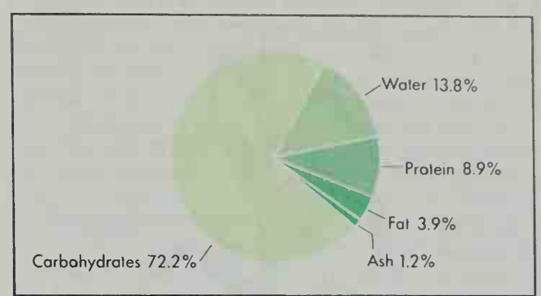
Corn also serves as an important ingredient in many processed foods. A typical supermarket might carry hundreds of foods that contain corn or corn products. Such foods include breakfast cereals, salad dressing, margarine, syrup, cornstarch, and snack items. Corn meal, a flourlike substance made from ground corn

grain, comes in such foods as corn bread, tamales, and tortillas. Corn is also an ingredient in beer and whiskey.

Livestock feed. Corn provides a major livestock feed in many countries. In the United States, about half the corn grain harvested each year becomes feed for hogs, cattle, sheep, and poultry. About 10 percent of the U.S. corn crop is made into *silage,* or livestock feed. Farmers produce silage from entire corn plants, except for the roots, or from the parts that remain after the ears are removed. Livestock also eat feed made from ground ears, whole shelled corn, or ground shelled corn.

Industrial uses. Manufacturers use corn to make many industrial products. Such products include ceramics, explosives, construction materials, metal molds, paints, paper goods, and textiles. Industrial alcohols, including ethanol and butyl alcohol, also contain corn. Alcohol made from corn and other plants is used in some gasolines to improve the fuel's performance and to make the fuel safer for the environment. Corn also comes in penicillin and other antibiotics, vitamins, and industrial enzymes.

Food value of whole-grain field corn



Source: *Composition of Foods—Raw, Processed, Prepared,* Agriculture Handbook No. 8, Agricultural Research Service, U.S. Department of Agriculture, 1975.

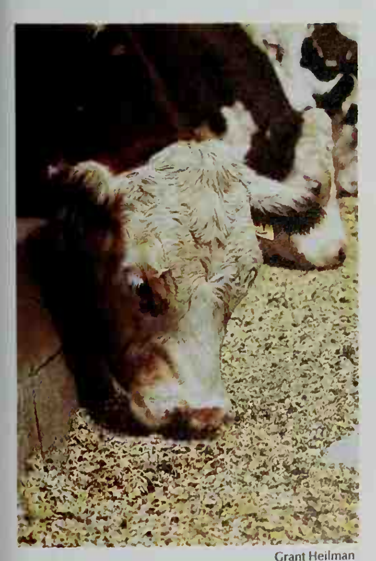
The corn plant

There are several thousand varieties of corn. Originally, varieties were developed by the farmers who grew them. Today, scientists develop nearly all corn varieties used on commercial farms. Varieties grown in the same region may have many characteristics in common but differ greatly from varieties in other regions. For example, most Corn Belt varieties grow about 8 feet (2.4 meters) tall. Varieties in other regions may range from as little as 3 feet (0.9 meter) to as much as 20 feet (6 meters) tall. If the similarities among varieties are great enough, the varieties are considered to belong to the same *race.* Scientists have identified about 250 corn races. However, all varieties develop in the same manner and can breed with one another.

Appearance. A mature corn plant consists of the roots, stalk, leaves, and flowering parts. The typical Corn Belt plant has a single sturdy stalk supported by a root system with many branches. About 20 long, broad leaves grow along the stalk, and 15 of these survive to maturity. The flowering parts of a corn plant are the *tassel,* the male reproductive structure at the top of the stalk, and the *ear,* the female reproductive structure about in the middle of the stalk. An ear consists of a cob covered by rows of kernels. The ear is enclosed and protected by special leaves called *husks.* A plant may have one or several ears. Most Corn Belt varieties bear one ear about 9 inches (23 centimeters) long per plant. Each ear has about 18 rows of kernels.

How the plant develops. A corn plant begins life as a seed. Mature corn seeds have three main parts: (1) the embryo, or germ; (2) the endosperm; and (3) the seed coat, or fruit case. The embryo is the part of the seed that develops into a new plant. The endosperm is a storehouse of food energy, mostly in the form of starch. The corn seedling uses that energy in its early development. The seed coat is a thin, tough outer covering around the endosperm and embryo that protects them from damage.

Physical development of the new corn plant begins



Grant Heilman

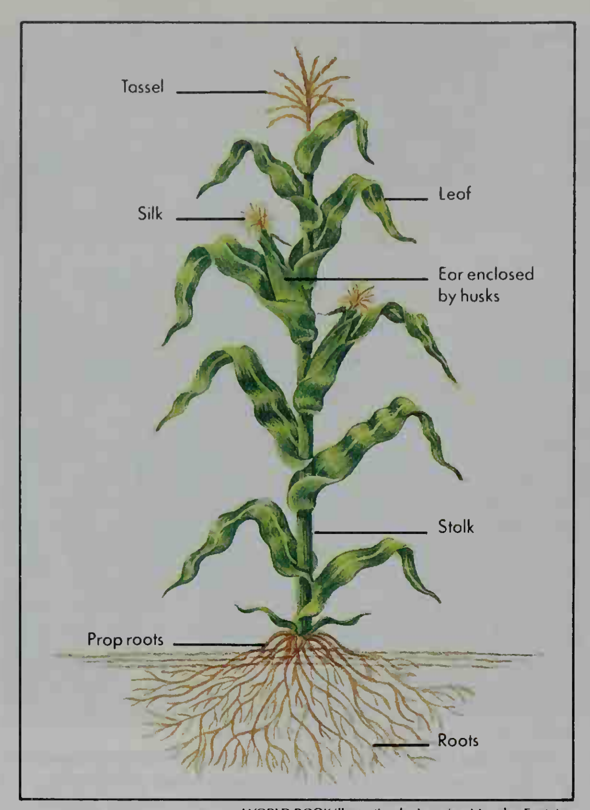


WORLD BOOK photo



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Uses of corn. Corn is made into many forms of nutritious feed, including flaked corn, *left.* People eat corn by itself or as an ingredient in a wide variety of foods, *center.* Manufacturers use corn in making such products as cosmetics, paper goods, and textiles, *right.*



WORLD BOOK illustration by Lorraine Moseley Epstein

A mature corn plant consists of the roots, stalk, leaves, ears, and tassel. Special leaves called *husks* enclose the ears. Long, threadlike *silks* extend beyond the tips of the husks.

two or three days after the seed is planted. Moisture absorbed by the seed causes it to swell. The lower part of the embryo, called the *primary root,* breaks through the seed coat and pushes down into the soil. One or two days later, several *seminal roots* start to form. Those roots are usually temporary. They anchor the seedling and absorb water and nourishment from the soil. About three to five days later, the upper part of the embryo breaks through, and the first leaves emerge.

Additional leaves appear during the next three or four weeks as the cornstalk grows taller. After four to six weeks, when all the leaves have started growing, the tassel, which is not yet visible, begins to form at the top of the plant. About the same time, buds start to form where the stalk and lower leaves meet. The lowest buds may form branches called *tillers.* Higher buds will develop into one or more ears. The plant then enters a period of rapid growth. During that time, which lasts about five or six weeks, a permanent root system develops and the leaves grow to their largest size. The flowering parts continue to develop. *Prop roots,* also called *brace roots,* extend into the ground from the lower part of the stalk and provide additional support to the plant. The plant reaches its full size about 9 to 11 weeks after sprouting.

How the plant reproduces. A corn plant reproduces sexually. *Sperm* (male sex cells) from the pollen released by the tassel unite with *eggs* (female sex cells) in the ear in a process called *fertilization.* The fertilized eggs develop into kernels on the cob.

A tassel consists of small male flowers that grow in clusters. Each flower has three baglike structures called *anthers,* which produce pollen. An anther may contain as many as 2,500 pollen grains.

An unfertilized ear of corn consists of female flowers arranged in pairs on a cob. In most varieties, only one flower of each pair develops and is able to reproduce. Each developing flower sends out a long, threadlike *silk* from its *ovary,* an egg-bearing structure at the base of the flower. At blossoming time, a mass of silks extends beyond the tip of the husks.

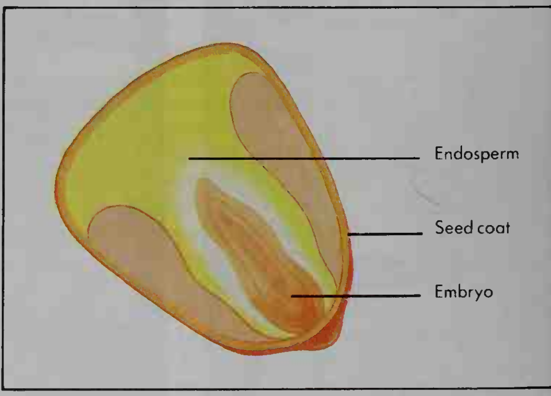
When the corn plant has nearly reached its maximum height, its anthers split open and shed their pollen. The pollen shed usually lasts five to eight days. The wind blows the pollen about like dust. Most of the pollen falls on other corn plants, though some self-pollination will occur. When a pollen grain lands on a silk, it germinates and sends a *pollen tube* down through the silk. Two *sperm nuclei,* male structures that fertilize, travel down the tube. One nucleus fertilizes the egg inside the ovary, forming the embryo of the new seed. The other unites with two female structures called the *polar nuclei,* forming the endosperm. In a commercially grown plant, the kernels reach maturity about eight weeks after fertilization. The rest of the plant dies at that time or soon after.

Kinds of corn

Biologists classify corn in many ways. One useful classification system is based on the different characteristics of the kernels. According to this system, the six major kinds of corn are: (1) dent corn, (2) flint corn, (3) flour corn, (4) sweet corn, (5) popcorn, and (6) waxy corn.

Dent corn gets its name from the dent on the top of mature kernels. The dent forms when the soft, floury starch in the center of the kernel dries and shrinks as the seed matures. Most kernels are yellow or white. Dent corn ranks as the most common corn in North America. It is used chiefly for livestock feed. It is also used in making many processed foods and industrial products.

Flint corn has hard, round kernels with a smooth coat. The kernels range from white to deep red. Flint corn grows well in cool climates and reaches maturity early. It resists insect pests that attack kernels better than corn with softer kernels, such as dent corn. The Ameri-



WORLD BOOK illustration by Lorraine Moseley Epstein

A mature corn seed has three main parts. (1) The *embryo* develops into a new plant. (2) The *endosperm* stores starch and other food energy. (3) The *seed coat* protects the parts.

can colonists found that breeding flint corn with dent corn produced a superior dent variety. Like dent corn, flint corn is used as food for people and livestock. In the fall, many people decorate their homes with ears of flint corn or other colorful corn. People often call such corn Indian corn. Flint corn is widely grown in Asia, Europe, and Central and South America.

Flour corn is one of the oldest kinds of corn. The Indians of central Mexico and western South America have grown flour corn for thousands of years. The kernels on most ears are white, blue, or a variety of colors. The kernels contain mainly soft starch and can be easily crushed into a flour. Farmers cultivate most flour corn in the southwestern United States, western South America, and South Africa. This corn mainly provides food for the people who grow it.

Sweet corn is the sweetest corn. People eat the cooked kernels directly from the cob or after they have been removed. Sweet corn is harvested before the kernels mature so it has the sweetest flavor. The kernels are soft and may be white or yellow. People grow sweet corn chiefly in the northern United States and the southern part of the Canadian province of Ontario.

Popcorn is a highly popular snack food. Like flour corn, it is one of the oldest kinds of corn and was grown by American Indians thousands of years ago. There are two main types of popcorn—*pearl popcorn* and *rice popcorn.* Pearl popcorn has rounded kernels that are usually yellow or orange. Rice popcorn, also called *hull-less popcorn,* has pointed, white kernels. Popcorn kernels possess a very hard endosperm with a small amount of soft, moist starch in the center. Steam created inside the kernels during heating causes them to explode, or pop. They turn inside out and produce a light, fluffy mass. The United States produces almost all the world's popcorn. See **Popcorn**.

Waxy corn gets its name from the waxlike appearance of its endosperm. The endosperm consists almost entirely of a starch called *amylopectin.* Such starch is especially useful as a thickener in manufacturing instant pudding mixes, gravies and sauces, and glues. Most waxy corn is grown in the United States and China.

Hybrid corn

Farmers in most developed countries grow *hybrid corn* almost exclusively. Plant breeders develop such corn to produce high yields.

Hybrid corn is developed through *controlled crosses.* In this process, breeders select varieties of corn with the characteristics they want future generations of corn to inherit. For example, one variety of dent corn may resist diseases better than another variety. However, the second variety may produce larger ears than the first variety. The plant breeders then cause plants of each selected variety to *inbreed* (self-pollinate) for several generations until plants with pure *hereditary lines* (ancestry) are established. They then cross the two inbred lines to obtain seed of a *single-cross hybrid.* Such seed, if properly developed, will produce uniform plants that combine the hereditary traits of their inbred parents and yield more than the parents. This increased yield capacity is known as *hybrid vigor.*

Farmers who grow hybrid corn do not save their own seed for planting the following year's crop. This is because plants grown from such seed will be of varying quality and yield less. As a result, corn farmers must purchase new single-cross hybrid seeds for planting the crop each year. Most breeders of hybrid corn use dent corn. See **Hybrid**.

Where corn is grown

There are so many varieties of corn with such different growing needs that one variety or another can grow in most *temperate* (mild) and tropical areas. Each year, about 660 million tons (600 million metric tons) of corn are produced worldwide on about 350 million acres (140 million hectares) of land. The annual harvest exceeds 23 billion bushels (600 million metric tons).

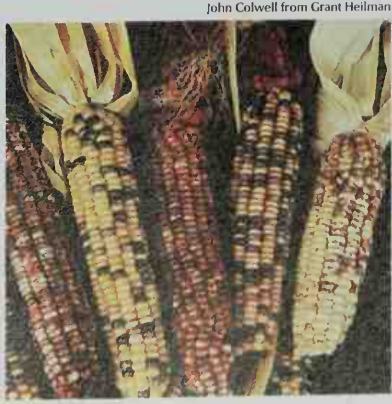
Corn production in the United States accounts for about two-fifths of the world's grain corn supply. About three-fourths of the U.S. crop comes from the Corn Belt, which covers parts of Illinois, Indiana, Iowa, Michigan, Minnesota, Missouri, Nebraska, Ohio, South Dakota, and Wisconsin. The United States also ranks as the world's top producer of corn for silage. About a fourth of the yearly grain corn harvest in the United States is exported, accounting for about half the world's total corn exports.

Corn production in other countries. China ranks as the second largest producer of corn in the world. It produces about a fifth of the world's supply. Other leading producers of corn include Argentina, Brazil, France, Mexico, and Romania. Argentina, France, and South Africa are among the leading corn-exporting countries

Larry Lefever from Grant Heilman







Corn ears can differ in the color of their kernels. The ears of dent corn, *pictured far left,* usually have yellow or white kernels. Indian corn, *pictured left,* refers to corn with multicolored kernels. Dent corn ranks as one of the most widely grown kinds of corn. People use it chiefly for livestock feed or silage. Types of Indian corn include flint corn and flour corn. People often decorate their homes with Indian corn in the fall.

Leading corn-growing states



*One bushel equals 56 pounds (25 kilograms). Does not include corn used for forage, grazing, or silage. Excludes sweet corn.
Figures are for a three-year average, 1998-2000.
Source: U.S. Department of Agriculture.

in the world. Japan ranks as the world's largest importer of corn. Ontario and Quebec produce the vast majority of corn grown in Canada.

How corn is grown

Most types of corn have a growing season of four to six months, usually beginning in April or early May. Much of the world's high yield corn is grown on large farms that use modern machinery to perform nearly all the operations involved in producing corn. However, more than half of the world's corn-producing areas lie in developing countries, where people grow the grain to feed themselves. Such farming accounts for about one-fifth of the world's corn production.

Growing conditions. Most kinds of corn grow best in loamy, well-drained soils that range from slightly acid to neutral. Corn also needs such *nutrients* (nourishing substances) as nitrogen, phosphorus, and potassium. Those and other nutrients are generally added to the soil in the form of chemical fertilizers or manure. Many corn farmers also rotate their corn crop each year with such crops as alfalfa, clover, or soybeans. Crop rotation returns some nutrients to the soil and helps control soil erosion, weeds, insects, and diseases.

Most types of corn produce the highest yields at daytime temperatures of about 86 °F (30 °C) and average nighttime temperatures above 50 °F (10 °C) around flowering time. Ideal rainfall for growing is 18 to 25 inches (46 to 64 centimeters) in temperate regions and 25 to 36 inches (64 to 91 centimeters) in the tropics.

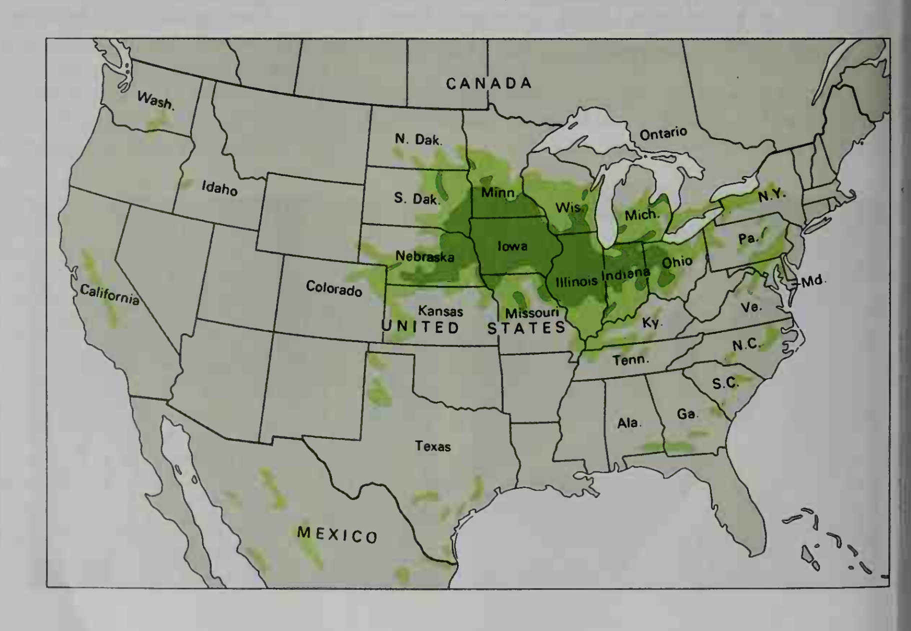
Preparing the soil. Many corn farmers use a *chisel plow* to prepare soil for planting. This plow ruptures the soil to a depth of 6 to 10 inches (15 to 25 centimeters) in rows spaced 12 to 16 inches (30 to 41 centimeters) apart. Such soil preparation leaves the field surface rough and with a significant cover of crop *residue* (remains), giving the soil greater protection against erosion. Farmers may add chemical fertilizers or manure to the soil before plowing, at planting time, or as the plants grow. Immediately before planting, the ground may be tilled shallowly one or more times to break up clods of earth and produce an even, firm seedbed.

Planting begins when the soil temperature reaches about 55 °F (13 °C). Farmers generally begin planting in early spring. Seeds are usually planted about 2 inches (5 centimeters) deep in rows from 15 to 30 inches (38 to 76 centimeters) apart. But they may be planted at shallower or deeper levels, depending on the type of soil and its temperature and moisture content. The most commonly used corn-planting machines are called row planters. They can plant from 2 to 31 rows of seeds at a time. In the Corn Belt, farmers usually plant 6 to 12 rows at a time. Farmers may grow 28,000 to 35,000 plants per acre

Corn-producing areas in the United States

About three-fourths of the U.S. corn crop comes from the Corn Belt, where the climate and soil are ideal for growing corn. The Corn Belt extends from Nebraska to Ohio and from Minnesota to Missouri. Smaller amounts of corn are grown in Washington, California, and many Eastern and Southern states.

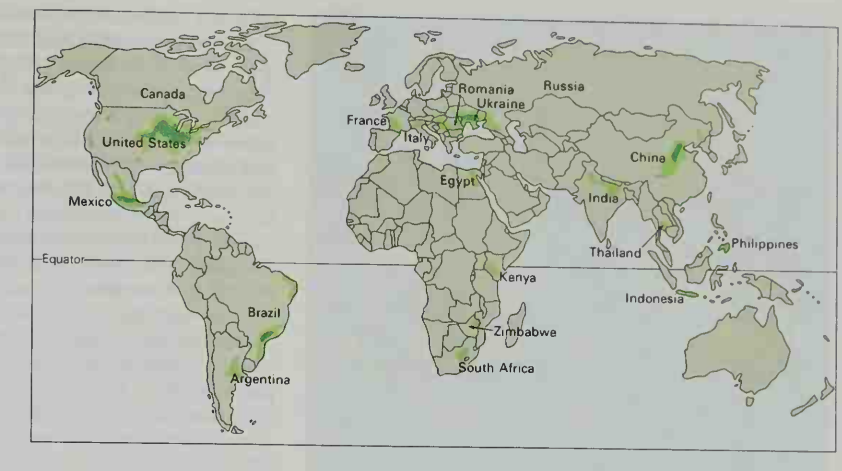


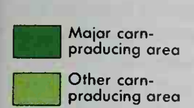


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Corn-producing areas of the world

The United States produces about two-fifths of the world's grain corn supply. Other important corn-producing countries include Argentina, Brazil, China, France, Mexico, and Romania.





WORLD BOOK map

(70,000 to 86,500 per hectare), depending on soil fertility, rainfall, and the availability of irrigation water.

Controlling pests and diseases. The major threats to corn crops are weeds, insects, birds, and fungi that cause such diseases as ear rot, stalk rot, and root rot. Chemicals also help protect corn from pests. Farmers use herbicides to control weeds, insecticides to control certain seed- and root-eating insects, and fungicides to control fungi that rot seeds. However, such chemicals can cause pollution if they are released into the environment.

Since the early 1900's, farmers have used hybrid corn that can resist insects and diseases. In the late 1990's, scientists introduced new kinds of corns called *GMO corns. GMO* stands for *genetically modified organism.* Scientists developed GMO corns by modifying the *genetic* (hereditary) makeup of certain corn varieties. These genetic modifications made the corn resistant to pests and diseases that once could only be eradicated through chemical pesticides. Since farmers began using GMO corns, they have reduced their need for certain pesticides. However, GMO corns have not achieved widespread acceptance because many people oppose growing and consuming genetically modified foods. One concern raised by such opponents is that genetically modified crops may cause illness in people and livestock.

Harvesting. The harvesting of corn for grain begins when the moisture content of the mature kernels has dropped to about 28 percent. However, many farmers will delay the harvest until the grain is drier to reduce artificial drying costs. Harvesting may take place as early as August or as late as October. Almost all harvesting is done with a *corn combine,* a machine that picks the ears from the stalks, removes the husks, shells the corn, and cleans it in one operation (see Combine). The shelled grain is then dried with heated air and stored in bins for later sale or for use on the farm as livestock feed.

Harvesting corn for silage begins when the kernel moisture has dropped to about 50 percent and the overall moisture of the plant is about 65 percent. A machine called a *forage harvester* cuts up to eight rows of plants at a time near ground level. It then chops the plants into small pieces and blows the pieces into a wagon. The chopped corn is packed into a storage place, where chemical changes called *fermentation* occur in the silage. Fermentation preserves the silage until it can be used.

Corn in industry

Grain corn that is not used on producing farms to feed livestock is sold for export or to industry for processing. Four main industries process corn. They are, in order of the quantity of corn used: (1) the mixed-feed industry, (2) the wet-milling industry, (3) the dry-milling industry, and (4) the fermentation and distilling industry.

The mixed-feed industry uses whole grain corn and by-products of the other industries to make livestock and pet feeds. Manufacturers usually grind or crack the whole grain and then add other ingredients to produce a tasty, nutritious feed. They often shape the feed into pellets, which keep the ingredients from separating.

The wet-milling industry chiefly produces cornstarch. Manufacturers use cornstarch in making bakery items, corn syrup, drugs, laundry starch, paper goods, textiles, and many other products. By-products of wet milling include corn oil and animal feed, such as corn germ meal and corn gluten meal. Corn oil is used in such foods as salad dressing and margarine.

In the wet-milling process, cleaned and shelled corn is soaked in warm *alkaline* (acid-neutralizing) water for 24 to 48 hours to soften the kernels. The processors then coarsely grind the kernels, which frees the germ, or embryo, from each kernel. The germ is removed for use in corn oil and corn germ meal. The remaining material is finely ground and passed through screens to remove the seed coat and larger fragments. The material that passes through the screens consists of starch and a protein substance called *gluten.* The gluten is removed for use in corn gluten meal. The starch that remains is pure cornstarch.

The dry-milling industry separates the kernel parts and processes them into corn meal, corn flour, grits, or corn oil. Manufacturers use those products to make such items as cornflakes, explosives, and snack foods. There are two systems of dry milling: (1) the new process system and (2) the old process system.

The new process system, or *degerming system,* processes about 80 percent of the corn used by the dry-milling industry. In this system, processors first clean the



Grant Heilman

Row planters can plant from 2 to 31 rows of corn at a time.

kernels and then increase their moisture content by treating them with water or steam. The grain is then fed into a machine called a *degermer.* The degermer separates the germ and the seed coat from the endosperm by coarse grinding. It also breaks up the endosperm and passes the particles through screens that sift out the large pieces. Processors use the germ to make corn oil and corn germ meal. They use the seed coats and bits of the kernel stuck to them to make an animal feed known as *hominy feed.* The largest endosperm pieces, called *flaking grits,* are used to make cornflakes. The remaining endosperm pieces are ground to produce such products as brewers' grits, corn meal, and corn flour.

The old process system, or *nondegerming system,* involves grinding whole corn kernels into corn meal called *old process meal* or *whole corn meal.* The meal generally has all parts of the kernel, though some meal is made without the seed coat. Old process meal has a high oil content from the germ and cannot be stored long. It is used to make tortillas and snack foods.

The fermentation and distilling industry uses corn grain to produce alcohol. To produce alcohol from corn, many processors first remove the germ through coarse grinding. They then grind the remaining material into a meal and cook it to produce a *mash.* Barley malt and water are also cooked into a mash. The two mashes are combined, and enzymes in the barley malt convert the starch in the combined mash to sugar. The processors next add yeast or bacteria to the mash, which cause the sugar to ferment, or convert to alcohol. Manufacturers can then remove and purify the alcohol from the fermented mash by *distillation.* Distillation involves turning the alcohol into vapor by heating the mash and then cooling the vapor back into a liquid. Products and by-products of the fermentation and distilling industry include beer and whiskey, antibiotics, industrial enzymes, vitamins, and distillers' feeds.

History

Scientists have determined that a strain of the grass *teosinte* is the direct ancestor of modern corn. Teosinte still grows wild in parts of Mexico's western Sierra Madre. The ear of this plant is very unlike that of cultivated corn, and scientists do not know exactly how Native American farmers transformed the teosinte ear into the corn ear. This transformation probably took farming cultures many centuries to achieve.

The oldest known fossil corncobs date from more than 6,000 years ago. They measure about 1 inch (2.5 centimeters) long and often bore less than 10 kernels.

Expansion of corn production. The cultivation of corn gradually spread to much of the Americas. Corn was most widely cultivated by the large urbanized civilizations, such as the Aztec of central Mexico, the Maya of southern Mexico and northern Central America, and the Inca of western South America. By the late 1400's, Native Americans grew corn as far south as Argentina and Chile and as far north as Canada.

Europeans knew nothing of corn until Christopher Columbus landed in Cuba in 1492. Columbus brought some corn seeds from the island back to Spain. Later explorers introduced corn from other parts of the Americas into many areas of the world. By the late 1500's, corn

J. C. Allen and Son



Corn harvesting is done almost entirely with a *combine, shown here.* The combine picks the ears from the stalks, removes the husks, and shells and cleans the corn. The shelled grain is then carried away for drying and storage.

had become a well-established crop in Africa, Asia, southern Europe, and the Middle East.

Corn was a basic food in the American Colonies during the 1600's and 1700's. The colonists learned how to grow corn from Native Americans. During the 1800's, demand for corn increased rapidly in the United States, and corn became a major commercial crop. Production soared as farmers competed for the growing livestock feed market.

Mechanization of corn farming. Before the 1800's, farmers used wooden or cast-iron plows. The heavy, gummy soil of the Midwestern prairies stuck to the surface of such plows, making it difficult to turn the soil. The problem was solved in 1837, when an American inventor named John Deere introduced the steel plow (see **Deere, John**). The sticky soil slid off Deere's smooth steel plow, enabling farmers to work the rich land of the Corn Belt far more easily.

Mechanical corn planters were developed in the early 1800's. Mechanical corn pickers came into common use during the 1930's and 1940's. Today, almost all grain corn is harvested by combines that pick, husk, shell, and clean the corn in one operation.

Development of hybrids. During the early 1900's, an American geneticist named George H. Shull began experiments to produce vigorous, high-yielding hybrid corn. Shull established pure hereditary lines by inbreeding plants of the same variety. He then crossed two inbred lines to develop the first *single-cross hybrids,* which displayed vigor. But because the inbred parents produced very low hybrid seed yields, seed production was costly. About 1918, another American geneticist, Donald F. Jones, bred two single-cross hybrids and developed the first *double-cross hybrids.* The single-cross female parent produced enough double-cross hybrid seeds to lower production costs and so make hybrids commercially important. Producers began selling double-cross hybrid corn seed in the 1920's.



Corn Refiners Association

The wet-milling process is used mainly to produce cornstarch. The equipment shown here removes the embryos from water-softened corn kernels in the beginning of the process.

By the 1960's, producers had begun marketing single-cross hybrids that produced more uniform, vigorous plants with higher yields than double-cross hybrids. Today, most corn seed comes from single-cross hybrids.

Beginning in the late 1900's, scientists developed a number of genetically modified corns, or GMO corns. Many GMO corns resist difficult diseases and pests. At the same time, other scientists used more traditional breeding techniques to produce corn with greater nutritional value. One type, the Mexican-produced quality protein maize, may provide a source of protein to people in developing countries. Ricardo J. Salvador

Scientific classification. Corn belongs to the grass family, Poaceae or Gramineae. Its scientific name is *Zea mays.*

Related articles in *World Book* include:

Alcohol	Corn syrup	Iowa (picture)
Alcoholic beverage	Cornstarch	Plant
	Farm and farming	Popcorn
Chinch bug	Grain	South Dakota (Places to visit)
Corn borer	Grass	
Corn earworm	Hybrid	Starch

Outline

I. Uses of corn
- A. Food for people
- B. Livestock feed
- C. Industrial uses

II. The corn plant
- A. Appearance
- B. How the plant develops
- C. How the plant reproduces

III. Kinds of corn
- A. Dent corn
- B. Flint corn
- C. Flour corn
- D. Sweet corn
- E. Popcorn
- F. Waxy corn

IV. Hybrid corn

V. Where corn is grown
- A. Corn production in the United States
- B. Corn production in other countries

VI. How corn is grown
- A. Growing conditions
- B. Preparing the soil
- C. Planting
- D. Controlling pests and diseases
- E. Harvesting

VII. Corn in industry
- A. The mixed-feed industry
- B. The wet-milling industry
- C. The dry-milling industry
- D. The fermentation and distilling industry

VIII. History

Questions

Where and by whom was corn first used for food?
Why does popcorn pop?
How many races of corn are there?
How was corn introduced into many areas of the world?
What are single-cross hybrids?
Why do many farmers rotate their corn crop each year with other crops?
Why is pod corn raised?
What are the three main parts of mature corn seeds?
What is the chief product of wet milling?
Why did the steel plow enable farmers to work the rich land of the Corn Belt far more easily?

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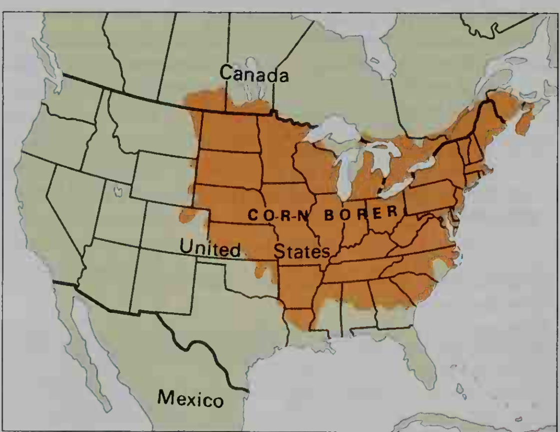
Corn is a small, hard, shiny thickening of the *epidermis* (outer layer of the skin). This thick growth presses on the *dermis* (deeper skin layer) and causes it to become thin and tender. Pressure and friction cause corns to form. Therefore, corns often develop over the joints of the toes of individuals who wear shoes that do not fit properly. However, corns may form anywhere on the body where pressure and friction injure the skin. A *soft corn* is one that is located between the toes. Here the thickened skin remains soft because it is constantly bathed with sweat.

Corn plasters remove the thickened epidermis and are used to relieve the pain of corns. Most plasters contain chemicals that soften the outer horny accumulation. To cure a corn, the things that caused it to form must be removed. Because of the danger of infection, paring corns with sharp instruments should be done only by a doctor. Paul R. Bergstresser

See also **Callus**.

Corn Belt. See Corn (introduction; Corn production in the United States).

Corn borer, also called the *European corn borer,* is a serious insect menace to corn crops. The borer is the larva of a night-flying moth. It is pinkish with small brown spots. The female moths begin to lay eggs on corn leaves in early June. The tiny borers feed on the young leaves and tassels. As they grow larger, they feed on the stems and ears. One or more generations of borers appear each year, depending on the length of the growing season. In winter, the larvae live in old corncobs, stems, and stubble. The corn borer eats chiefly corn and sorghum. But it attacks other plants, including



WORLD BOOK map

The corn borer came to the United States from Europe about 1910. It spread through the Eastern and Midwestern states, causing damage to the corn crop in the orange areas on the map.

celery, potatoes, beans, flowers, and weeds.

Farmers destroy corn borers during the winter by feeding cornstalks to livestock, or by shredding or burning the stalks. They plant late in the season to avoid the first flight of the moths, and use hybrid corn plants that are not affected by the corn borer. In some cases, farmers use insecticides. John R. Meyer

Scientific classification. The European corn borer belongs to the snout moth family, Pyralidae. It is *Ostrinia nubilalis.*

Corn earworm, also called *bollworm,* ranks among the worst insect pests in the United States. Most corn earworms are greenish-brown with dark stripes. They measure about 1 $\frac{1}{2}$ inches (4 centimeters) long. The adult is a grayish-brown moth.

On corn, the moths usually lay their eggs on the silk. The eggs hatch in two to eight days. As far north as Kentucky, three broods of the insects appear each year—in June, July, and August. Farther north, two broods are normal. To the south, as many as five broods may occur. Corn earworms also attack cotton, tomatoes, alfalfa, beans, and other crops. The corn earworm is called the *bollworm* when it attacks cotton bolls. Farmers plow under all crop remains and use crop varieties resistant to corn earworms to control the insects. Insecticides also may be needed to protect some crops. John R. Meyer

Scientific classification. The corn earworm is in the owlet moth family, Noctuidae. Its scientific name is *Helicoverpa zea.*

Corn Laws were enforced in Britain from the 1400's to 1846 to control the price of grains, called *corn* by the British. The laws protected British grain producers from foreign competition. The Corn Laws usually balanced the interests of producers with those of consumers. For example, as the population grew in the 1700's, grain imports were permitted if prices rose too high.

During the Napoleonic Wars (1793-1815), the British banned grain imports, and landowners made huge profits. After the wars ended, new Corn Laws kept grain prices high. The Anti-Corn Law League, a group of merchants and manufacturers, wanted the laws repealed. Bread was so expensive that many people could not afford products made by British factories. Parliament repealed the Corn Laws in 1846. British agriculture then declined, but British industry grew. Marjorie Bloy

See also **Cobden, Richard; Peel, Sir Robert.**

Corn oil is a vegetable oil made from the kernel of the corn plant. It is used mainly as a cooking and salad oil and in such food products as margarine and potato chips. Refined corn oil has a pale, yellow color.

The United States produces most of the world's corn oil. During processing, machines separate the undeveloped new plant called the *germ* or *embryo* from the rest of the kernel. The germ contains about 20 percent oil. The oil can be squeezed from the germ, or it can be obtained by *solvent extraction.* This method involves treating the germs with a liquid solvent, which separates the oil from the germ. Corn oil is about 55 percent polyunsaturated fat, a substance many nutritionists consider essential to a healthy diet (see **Fat**). Daniel R. Sullivan

See also **Corn** (Uses of corn; Corn in industry).

Corn snake. See **Snake** (pictures: How a snake swallows its prey; Some harmless snakes).

Corn State. See **Iowa.**

Corn syrup is a thick, sweet liquid made from cornstarch. Food processors use it to sweeten baked goods, candies, canned fruits, ice cream, and soft drinks. It also flavors ketchup, peanut butter, salad dressings, processed meats, and many other foods. Corn syrup gives creams and candies a smooth texture. It also attracts and holds moisture, and so it helps prevent baked goods from becoming stale.

Manufacturers make corn syrup from a mixture of cornstarch and water. To this mixture they add a weak acid solution or certain *enzymes* (molecules that speed

up chemical reactions). This converts the starch to sugar. The resulting corn syrup consists mainly of two sugars, *glucose* and *maltose,* and a sticky substance called *dextrin.* To make a sweeter syrup, manufacturers add another enzyme, which changes some of the glucose in the syrup to a sweeter sugar called *fructose.* Further treatment of the syrup produces *high-fructose corn syrup* (HFCS). Many food processors use HFCS because it costs less and is much sweeter, but not higher in calories, than other sweeteners. Roger E. Wyse

See also Sugar (Cornstarch and other starches).

Cornea. See Eye (The sclera and the cornea).

Corneille, *kawr NAY,* **Pierre** (1606-1684), was a French playwright. He is often called the father of French tragedy, but he is more truly the founder of French heroic comedy. Corneille favored tragicomedy and melodrama over conventional tragedy.

Corneille is best known for his tragicomedy *The Cid* (1636 or 1637). The French Academy condemned the play for breaking several "classical" rules. These rules held that a play should consist of a single plot in a single location within a day's time. Violence was also prohibited on stage. Although *The Cid* broke these rules, it enjoyed great popularity. It was the first French drama to center on the characters' inner psychological conflict rather than on external changes alone. *The Cid* also brought to the French stage a new lyrical language to match the passionate nature of Corneille's heroes.

The subjects of most of Corneille's plays come from Roman history. Most of his leading characters, like their ancient models, show great pride, patriotism, honor, and stern courage. They are fearless, remorseless, and subject to violent emotions such as hatred, revenge, and superhuman ambition. Many of Corneille's plays reflect Spanish drama, especially in their heroes' passionate, boastful, and violent nature. This influence pleased his audience, a status-conscious society often at war.

Corneille's other famous plays include *Horace* (1640), *Cinna* (1640), *Polyeucte* (1642), and *Rodogune* (1644). He described his theories of drama in three *Discourses,* which were essays that served as prefaces to a three-volume edition of his plays published in 1660. Corneille was born in Rouen. Carol L. Sherman

Cornell, Ezra (1807-1874), was an American businessman, farmer, legislator, and philanthropist. He rose with the rapidly growing telegraphic communications industry, and helped organize the Western Union Telegraph Company. He became wealthy, and in his later years devoted his energies and fortunes to educational projects. He is particularly remembered for helping found Cornell University in 1865 (see Cornell University).

Cornell was born on Jan. 11, 1807, in Westchester, New York. His father was a poor potter and farmer, and Cornell received little formal education. After several false starts in various fields, Cornell invented a plow to lay cable for Samuel F. B. Morse's first telegraph line. He then became a leading builder of telegraph systems. Cornell became interested in agriculture in the 1840's, and became president of the New York State Agricultural Society in 1862. In the 1860's, he also served in New York's state Assembly and state Senate. Cornell died on Dec. 9, 1874. Elaine D. Engst

Cornell University is a coeducational institution and the *land-grant university* of the state of New York. A land-grant university is partly endowed by the United States government under the Morrill, or Land-Grant, Act of 1862 (see Land-grant university). Cornell has 13 schools and colleges. Eleven of them are on the main campus in Ithaca. The other two, the medical college and the graduate school of medical sciences, are in New York City. Seven of the schools in Ithaca are private, and four receive state support.

Cornell offers a wide range of courses in both the liberal arts and professional fields. The undergraduate units are the colleges of agriculture and life sciences; architecture, art, and planning; arts and sciences; engineering; and human ecology; and the schools of industrial and labor relations and hotel administration. Graduate study takes place in the schools of law and management, the college of veterinary medicine, and the graduate school. Programs of study lead to bachelor's, master's, and doctor's degrees.

Cornell University was founded in 1865. It was named for its founder, Ezra Cornell, an American businessman and philanthropist. Cornell students come from throughout the United States and from more than 90 other countries. Critically reviewed by Cornell University

See also Cornell, Ezra; New York (picture).

Corner Brook, Newfoundland and Labrador (pop. 20,103), is an important newsprint manufacturing center. Corner Brook lies on the western coast of the island of Newfoundland, on the Bay of Islands (see Newfoundland and Labrador [political map]).

Corner Brook has a paper mill that produces about 375,000 tons (340,200 metric tons) of newsprint annually. Plants in the city also process fish and manufacture cement, plasterboard, and other building materials. The city's excellent port facilities and roads make it one of the province's major distribution centers.

Beothuk Indians lived in what is now the Corner Brook area before Europeans arrived there. Captain James Cook, a British explorer, visited the area in 1767. He probably gave the name Corner Brook to a stream that runs through the city. The community was later named after the stream. In the early 1800's, white settlers came to the area because of its rich fishing. The town's economy centered on fishing until the paper mill began operating in 1923.

A junior college, the Sir Wilfred Grenfell College, opened in Corner Brook in 1975. It is affiliated with Memorial University of Newfoundland. Corner Brook has a mayor-council form of government. C. M. Holloway

Cornering the market was a technique used to accumulate all or most of the available supply of a stock or commodity. The buyer did this to raise the price of the stock or commodity at will. Cornering affected speculators who *sold short,* or sold stock they did not yet own but planned to buy at lower prices. The market corner forced those who needed a stock to pay high prices to the controlling group. Various stock exchanges and the Securities and Exchange Commission have outlawed cornering. They limit the prices at which a speculator may sell short, because these practices have caused serious fluctuations in the stock market. See also Fisk, James; Gould, Jay. Robert Sobel

Cornet is a brass musical instrument that resembles a shortened trumpet. Cornets and trumpets have the same range, but the cornet has a mellower tone quality. The

main part of a cornet is a coiled tube about 4 $\frac{1}{2}$ feet (1.4 meters) long. The tube has three valves. Different pitches are produced by vibrating the lips in a cup-shaped mouthpiece. Notes are played by changing the tension of the lips and by pressing the valves.

The cornet developed from a valveless brass instrument called a posthorn. The modern cornet appeared after valves were invented in the early 1800's and soon became the main melodic brass instrument in bands. Some composers also wrote cornet parts for symphony orchestras, often in combination with trumpets. Because of its brilliant tone and carrying power, the trumpet has almost completely replaced the cornet in jazz groups, concert bands, and marching bands.

Stewart L. Ross

See also **Trumpet; Jazz** (The brass).

Cornflower. See **Bachelor's-button.**

Cornplanter (1750?-1836) was a Seneca Indian leader. He supported Britain during the Revolutionary War in America (1775-1783). But in the 1780's and 1790's, Cornplanter helped prevent the Seneca from fighting in wars between Midwestern Indians and the United States government. In 1791, the Pennsylvania legislature rewarded his efforts to keep the Seneca out of the wars by granting him a large area of land on the Allegheny River. The *Cornplanter Grant* became a major Seneca settlement in 1796. Michael D. Green

Cornstalk (1720?-1777), a Shawnee Indian chief, became a central figure in Indian wars in Ohio during the late 1700's. He became alarmed when a conflict between other Ohio Indians and Virginians led to an invasion by two armies of Virginians in 1774. Cornstalk feared the Virginians would overrun Ohio, and so he led a Shawnee army against one of the Virginian forces. His warriors were defeated at the Battle of Point Pleasant in October 1774. The battle ended what was called Lord Dunmore's War, named after Virginia's governor. In 1777, Cornstalk was visiting Point Pleasant when other Indians killed a settler. A mob took revenge by killing Cornstalk, his son, and three other Shawnee. These murders led to years of warfare in Ohio. Cornstalk was probably born in Pennsylvania. Michael D. Green

Cornstarch is a fine white flour made by grinding and refining grains of corn. It is made of corn from which the seed-bearing part, called the *germ,* has been removed. The corn is ground in a process called *wet milling.* After removal of the corn proteins, the remaining cornstarch is dried in ovens. Since only 10 percent of moisture remains in the cornstarch after drying, it is often mixed with other foods to protect them from moisture. Manufacturers use cornstarch in bakery products, baking powder, candies, and salad dressing. They also use cornstarch in explosives, paints, and textiles. See also **Corn** (The wet-milling industry). Mary E. Zabik

Cornucopia, *kawr nuh KOH pee uh,* is a horn of plenty, a symbol of nature's productivity. According to Greek mythology, it was one of the horns of Amalthaea, the goat who nursed the god Zeus when he was a baby. The horn produced ambrosia and nectar, the food and drink of the gods. In Roman mythology, the cornucopia was the horn of the river god Achelous. The hero Hercules broke off the horn in combat with Achelous, who was fighting in the form of a bull. Water nymphs filled the horn with flowers and fruit and offered it to Copia, the goddess of plenty. Mary R. Lefkowitz

Cornwallis, Charles (1738-1805), the first Marquis Cornwallis, was a British general in the Revolutionary War in America. His defeat at Yorktown, Virginia, in 1781 was critical to the American triumph.

Cornwallis was born on Dec. 31, 1738, in London. He helped capture New York in 1776, then pursued General George Washington across New Jersey. He became second in command to Sir Henry Clinton in 1778. Invading North Carolina, he won a costly victory in 1781 at Guilford Courthouse against forces of General Nathanael Greene. Then, against Clinton's wishes, he moved into Virginia. A French fleet and French and American troops surrounded him at Yorktown. He surrendered there on Oct. 19, 1781. Cornwallis was commander in chief and viceroy of India from 1786 to 1793 and again in 1805. He was lord lieutenant and commander in chief of Ireland from 1798 to 1801. James Kirby Martin

Cornwallis, Edward (1713-1776), a British soldier and colonial official, led 2,500 settlers to Nova Scotia in 1749 and founded Halifax. After overseeing the initial settlement and establishing civil government, he served as governor and captain-general of Nova Scotia from 1749 to 1752. Cornwallis served in the British army from 1731 to 1748. He was governor of Gibraltar from 1762 until his death. Cornwallis was born on Feb. 22, 1713, in London.

Judith Fingard

Cornwell, Patricia (1956-), is an American author of detective fiction who created the character of Dr. Kay Scarpetta, medical examiner for the state of Virginia. Cornwell drew on her experiences as a police reporter and computer analyst for a medical examiner's office to create Scarpetta. She includes authentic details of autopsies and other medical procedures in her novels.

Cornwell introduced Scarpetta in *Postmortem* (1990), which won several awards as the best first mystery novel of the year. The Scarpetta novels soon became best sellers. They include *Body of Evidence* (1991), *All That Remains* (1992), *Cruel & Unusual* (1993), *The Body Farm* (1994), *From Potter's Field* (1995), *Cause of Death* (1996), *Unnatural Exposure* (1997), and *Point of Origin* (1998).

Patricia Daniels Cornwell was born on June 9, 1956, in Miami, Florida. She lives in Richmond, Virginia, the scene of the Scarpetta novels. Her first book was a biography of Ruth Graham, the wife of evangelist Billy Graham, *A Time for Remembering* (1983). She also wrote three novels about a former North Carolina police chief named Judy Hammer, *Hornet's Nest* (1997), *Southern Cross* (1999), and *Isle of Dogs* (2001). Jon L. Breen

Corona, *kuh ROH nuh,* is the outermost layer of the sun's atmosphere. It is visible to the unaided eye only during a total solar eclipse, when the remainder of the sun is hidden by the moon. At such times, the corona appears as an irregularly shaped halo of light. Many stars other than the sun also have coronas.

The sun's corona consists chiefly of electrons, hydrogen *ions* (electrically charged atoms), and ions of heavier atoms that have lost many electrons. These ionized particles and electrons form a gaslike substance known as a *plasma.* Atoms become ionized when their electrons absorb enough energy to leave the atoms. The corona is greatly ionized because it has an extremely high temperature, measured at 4,000,000 °F (2,200,000 °C).

Activity in the corona increases and decreases in an

11-year cycle called the *sunspot cycle*. Streaks of coronal plasma known as *polar plumes* spread outward from the sun's poles. Long, gaseous rays called *coronal streamers* radiate from areas closer to the equator. See Sunspot.

The corona continually expands into space, forming a flow of ionized particles called the *solar wind*. Astronomers believe that the solar wind flows mainly from *coronal holes,* regions of relatively low temperature and density. Coronal holes occur primarily around the sun's poles, but they sometimes appear at lower latitudes. The solar wind extends to the earth's orbit and beyond.

Astronomers observe the corona with instruments on the ground and in space. The best time to observe the corona from the ground is during a solar eclipse, an event that occurs about every 18 months. One of the main instruments used for viewing when there is no eclipse is a *coronagraph,* a telescope with a disk in the middle of its tube. The disk blocks out the light from lower layers of the sun's atmosphere. In 1995, the National Aeronautics and Space Administration (NASA) of the United States and the European Space Agency launched the Solar and Heliospheric Observatory (SOHO). This spacecraft observes the corona with coronagraphs and other instruments. SOHO observations show that, about once every day, the sun throws off a huge ball of plasma known as a *coronal mass ejection*.

NASA's Transition Region and Coronal Explorer (TRACE) satellite, launched in 1998, takes highly detailed pictures of the corona. Since 1991, Japan's Yohkoh spacecraft has mapped X rays from the corona.

Jay M. Pasachoff

Coronado, Francisco Vásquez de (1510?-1554), was a Spanish explorer. From 1540 to 1542, he led an expedition to the American Southwest in search of the legendary Seven Cities of Cíbola. Earlier Spanish explorers had told of these cities, which were said to be rich in gold and other treasures.

Coronado was born in Salamanca, Spain. In 1535, he sailed to Mexico with Antonio de Mendoza, the first viceroy of New Spain, which included what is now Mexico. Coronado became governor of New Galicia province, northwest of Mexico City, in 1538.

In 1539, Marcos de Niza, a Spanish missionary priest, returned to New Spain from a journey to the north. He claimed to have seen a golden city, Cíbola, among the Zuni Indians in the region. Niza's account and stories by Alva Núñez Cabeza de Vaca and other Spanish explorers led to Coronado's Cíbola expedition.

Coronado gathered his army in Compostela, the capital of the province of New Galicia, at the end of February 1540. He recruited more than 300 Spanish soldiers and more than 1,000 Indian soldiers and servants, many of whom were accompanied by their wives and children. In addition, several missionary priests went with the expedition.

In July, Coronado reached the place he identified as Cíbola, in the area of what is now Gallup, New Mexico. The Zuni Indians there fought to defend their territory, but the Spaniards defeated them and established a camp at the site. To the Spaniards' bitter disappointment, the town they thought was the legendary Cíbola was not a golden city. It was instead a small village



The Surrender of Lord Cornwallis at Yorktown (1817-1824), an oil painting by John Trumbull; Yale University Art Gallery

General Cornwallis surrendered his army to George Washington at Yorktown. This painting shows French and American officers, including Washington, lined up to receive the surrender.

called Hawikuh, which was inhabited by about 100 families.

From his base camp, Coronado sent smaller bands of soldiers under the command of others to explore to the west and the east. One of his men, Pedro de Tovar, led a force to the Colorado Plateau and the Painted Desert to the northwest. García López de Cárdenas and his party became the first Europeans to see the Grand Canyon. Coronado sent Hernando de Alvarado to explore the Rio Grande Valley.

In the winter of 1540, Coronado moved his headquarters near a cluster of about a dozen Pueblo Indian villages in a region called Tiguex, which was north of present-day Albuquerque, New Mexico. The winter brought shortages of food and clothing. After the Spaniards took supplies from the Pueblo by force, the Indians began to resist the Spaniards. In the war that followed, Coronado's army destroyed several villages.

The following spring, tempted by new stories of a city of gold called Quivira, Coronado led an expedition eastward across the Pecos River. He wandered through the panhandles of present-day Texas and Oklahoma and eventually reached what is now central Kansas before returning to New Mexico in the fall.

In the spring of 1542, Coronado returned to New

Coronado's expedition 1540-1542

This map shows the explorations of Francisco Vásquez de Coronado in the American Southwest. Coronado searched in vain for the legendary cities of Cíbola and Quivira. The present-day state boundaries are also shown.

Route of main expedition
Route of secondary expedition
Indian pueblo
Spanish settlement



WORLD BOOK map



Bettmann Archive

Francisco Vásquez de Coronado, shown in a painting by N. C. Wyeth, set out in 1540 to search for seven cities that were said to be stocked with gold and gems. Instead, he reached parts of the Rio Grande and central Kansas.

Spain. He remained governor of New Galicia until 1544. That year, he was suspended from his office during an investigation of his Cíbola expedition. In 1545, Coronado was charged with mistreatment of Indians, failure to colonize the lands he had explored, and other misconduct. In 1546, he was cleared of all wrongdoing.

Kevin Gosner

See also **Cíbola, Seven Cities of.**

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Coronary bypass surgery. See Heart (Coronary artery disease).

Coronary thrombosis, also called *coronary occlusion,* is a condition in which a clot blocks the passage of blood in an artery of the heart. The portion of the heart muscle supplied by the blocked artery then dies. The death of the muscle is called a *heart attack* or a *myocardial infarction.*

Symptoms of a coronary thrombosis include severe chest pain, shortness of breath, vomiting, and a weak and rapid pulse. A coronary thrombosis can cause death. If the patient survives, the condition leaves scar tissue in the area of the heart muscle supplied by the artery where the clot developed. Bruce A. Reitz

Coronation is a ceremony at which a king, queen, or pope publicly receives a crown as a symbol of rule. The ceremony is usually rich in color and tradition. A majority of coronations have religious as well as political features, and a religious official often performs the ceremony. In addition, the new ruler receives other official marks of royalty during the proceedings. When accepting this power, he or she usually makes a pledge to rule wisely.

The British coronation takes place in Westminster Abbey. The new monarch is conducted from the west door of the abbey along the nave to the crossing, where the ceremony is performed. First, the monarch sits in a Chair of Estate. The regalia—the crown, orb, scepter, rod, swords of state, spurs, ring, and bracelets that are

used in the ceremony—are placed on the altar. The archbishop of Canterbury then presents the monarch to the people in the abbey as the true ruler of the realm. The monarch takes the coronation oath, swearing to rule justly and to support the Church of England. The monarch receives a Bible, which is placed on the altar. The celebration of the Communion service of the Church of England then begins.

The service is interrupted after the Creed, and the monarch moves to King Edward's Chair, also called the Coronation Chair. Here the monarch is anointed and clothed in a cloak of gold cloth. The spurs of St. George, a symbol of knighthood, are presented. The Sword of State is taken from its scabbard and carried before the monarch during the rest of the ceremony. *Armills* (bracelets) are put on the wrists of the monarch. The monarch receives the *orb,* a globe of gold surmounted with a cross signifying the rule of Christ over the world. The Coronation Ring, symbolizing the marriage of the ruler and the kingdom, is placed on the monarch's right hand. The monarch receives a rod with a dove to hold in the left hand. The dove symbolizes the Holy Spirit. The monarch holds a scepter with a cross in the right hand. On top of the scepter is the *Star of Africa,* the largest cut diamond in the world. After the monarch receives these symbols of authority, the archbishop of Canterbury places the crown of St. Edward on the monarch's head.

The guns of the Tower of London fire a salute. The monarch moves to the throne after receiving a blessing from the archbishop. Nobles, carrying the swords of State, Temporal Justice, Spiritual Justice, and Mercy, surround the throne. The monarch gives the rod and scepter to an attendant, then receives pledges of loyalty from the clergy and the public.

The monarch then leaves the throne, removes the crown, and offers the archbishop the bread and wine for Holy Communion. The monarch takes Holy Communion and returns to the throne. Then the monarch receives the crown, scepter, and orb, and walks in procession down the nave, leaving the abbey through the west door. A banquet follows the coronation. In earlier times, a fully armed knight, the King's Champion, rode into the banquet hall to challenge anyone who questioned the monarch's right to the throne.

The British coronation ceremony is quite ancient. The earliest record of the ceremony dates from about the A.D. 750's. King Edward I made the Coronation Chair in about 1300 to contain the *Stone of Scone* (or *Stone of Destiny*), the Coronation Stone of kings of Scotland.

Development. Ancient Germanic tribes elected their rulers. The newly elected king received a spear, and a band of silk or linen was placed on his forehead. As the king sat upon a shield, his warriors lifted him to receive the acclamation of his followers.

According to a custom mentioned in the Bible, kings were anointed with chrism, a mixture of oil and balm. People thought that chrism gave the anointed ruler special miraculous powers. In England, popular belief held that a person who even touched the king's clothes could be cured of illness. In some coronation ceremonies, the ruler was ordained as one of the lower ranks of the clergy. I. J. Sanders

Related articles in *World Book* include:

Charlemagne (Military conquests)
Crown
Elizabeth II (picture)
Napoleon I (Crowned emperor)
Scone, Stone of
Westminster Abbey

Coroner. See Medical examiner.

Corot, *kaw ROH,* **Camille,** *ka MEE yuh* (1796-1875), was a French landscape and figure painter. His work formed an artistic bridge between the tradition of classical composition of the early 1800's and the romantic movement's concern with nature which led to impressionism.

Corot began to study painting against his parents' wishes. In 1825, he went to Italy, where he became concerned with the play of light and color values. He began painting in solid masses in order to produce light and

View of Genoa (1834), an oil painting on paper mounted on canvas; © The Art Institute of Chicago, Mr. and Mrs. Martin A. Ryerson Collection. All rights reserved.



A Corot landscape shows the port city of Genoa, Italy, in the glare of the midday sun. Many of the French artist's landscapes portray the play of light and color. Corot painted the scene during one of his many trips to Italy early in his career.

dark patterns of color. Corot's early work shows the influence of the French landscape painters Claude (Lorrain) and Nicolas Poussin, and of the Dutch landscape painters of the 1600's.

Corot returned to France in 1828 and traveled a great deal because a small income left him free from economic worries. He came under the influence of a group of nature painters in the village of Barbizon. Corot was called "the lyric poet" of this group. He changed his style and began painting everything as if it were seen through a delicate gray veil, accented by a few details of bright color.

Corot's artistic style underwent a final change in 1871. He again painted in the style of his youth, but his works were now drenched in Impressionist light and color.

Corot painted portraits for his own pleasure throughout his career. He also painted religious pictures. His portraits, along with his early and last paintings, are considered his best works. Corot was born Jean Baptiste Camille Corot in Paris. Ann Friedman

Corporation is a person or group of people who obtain a charter giving them certain legal rights and privileges. A corporation can own property, buy and sell, manufacture products, and bring lawsuits as if its members were one person. Business corporations are the most common type of corporation. Other types are municipal, government-owned, quasi-public, nonprofit, and single-person corporations. Business corporations make up only about 15 percent of all business enterprises in the United States. Partnerships and individual proprietorships form the remainder. However, business corporations account for more than 75 percent of all business assets.

Corporations are formed under *general incorporation laws.* People wishing to form a corporation file *Articles of Incorporation,* stating the purpose and makeup of the organization. A government official then issues a certificate that permits the corporation to exist. Investors in a corporation have *limited liability.* If the corporation fails, they can lose no more than their investment, because the corporation's debts are not their debts.

In the United States, state or federal government permission is required to form a corporation. State governments charter most corporations. National banks need federal approval. A corporation set up in one state can do business in other states if it files certain forms and pays required fees in those states.

Business corporations may be public or private. The most common type is the public corporation, which obtains funds by selling ownership shares, called *capital stock,* to large numbers of investors. There are two varieties of stock, *preferred* and *common.* Preferred stock does not extend voting rights in the corporation to stockholders but gives holders first claim on the company's assets after debts are paid. Common stock gives stockholders voting rights. Corporations reward stockholders for their investments by giving them part of the profits. These payments are called *dividends.*

When stock is first issued, the people forming the corporation determine the type of stock, the number of shares to be issued, and the price per share. Afterward, the stock value depends on the corporation's financial status. A corporation may raise funds by issuing new stock or by selling bonds. Bondholders do not have voting rights, but they have first claim on the corporation's assets. Stockholders and bondholders may sell their holdings. Most previously issued stocks and bonds are bought and sold on stock exchanges.

A public corporation is governed by a board of directors elected by common stockholders at regular meetings. The directors establish the policies of the corporation. The policies are carried out by officers chosen by the directors or by stockholders.

Most stockholders receive one vote for each share of common stock they own. The stock in most large corporations is widely distributed, and so a person or group owning much less than 51 percent can usually obtain effective control.

Private corporations, unlike public corporations, have a limited number of owners. Some private corporations are large firms. But most are small companies in which all or most stock is held by family members. In such corporations, owners usually manage the company, rather than appoint others to do so. There is no open market for the sale of stock of private corporations.

Other corporations. Cities and towns may form *municipal corporations* to operate certain government enterprises, such as sewer, water, and school districts. Federal, state, or local governments may establish *government-owned corporations* to provide certain public welfare functions. *Quasi-public corporations* join private and government investors in high-risk investment situations, such as the development of space satellites. In these ventures, the government usually subsidizes or insures the private investor. *Nonprofit corporations,* such as the Red Cross, provide community services. They consist of members instead of stockholders and provide no dividends. Certain highly paid individuals, such as motion-picture stars or professional athletes, form *single-person corporations* to take advantage of corporate tax benefits. Robert B. Carson

Related articles in *World Book* include:

Bond
Business
Cartel
Charter
Conglomerate
Franchise
Holding company
Joint-stock company
Law (Corporation law)
Limited company
Multinational corporation
Proxy
Stock, Capital

Corporation for Public Broadcasting is a private, nonprofit organization that promotes public television and radio in the United States. It is funded mainly by the federal government.

The corporation, often called the CPB, uses about two-thirds of its funds to support the nation's more than 1,000 public TV and radio stations. These stations broadcast primarily educational and cultural programs. The CPB finances the production and distribution of programs and conducts audience research.

The CPB was created by Congress in 1967 and began operating in 1968. The 10 members of its board of directors are appointed by the president, subject to the approval of the Senate. The CPB has headquarters in Washington, D.C.

Critically reviewed by the Corporation for Public Broadcasting

See also **Television** (Public stations).

Corporative state. See **Fascism** (Economic life).

Corps, *kawr,* is an army unit consisting of two or more divisions. The term *corps* comes from a Latin word

meaning *body.* A corps is normally composed of about 50,000 to 100,000 soldiers. Most corps are commanded by a lieutenant general. A corps can conduct major military operations. The word *corps* also refers to the U.S. Marine Corps and to such branches of the U.S. Army as the Corps of Engineers and the Signal Corps. See also **Army, United States** (table: Army levels of command).

Joel D. Meyerson

Corps of Engineers. See Engineers, Corps of.

Corpus Christi, *KAWR puhs KRIHS tee,* Texas (pop. 277,454; met. area pop. 380,783), is a major United States seaport and a center of industry and tourism. It lies on Corpus Christi Bay, near the Gulf of Mexico (see Texas [political map]). The city was named for the bay. Corpus Christi has a council-manager government.

Description. Corpus Christi, the county seat of Nueces County, covers 392 square miles (1,015 square kilometers). This area includes 276 square miles (715 square kilometers) of inland water. More than half the people of Corpus Christi are of Hispanic ancestry.

Corpus Christi has a mild climate and attracts many tourists and conventions. Temperatures in the city average 57° F (14° C) in January and 84° F (29° C) in July. For the monthly weather in Corpus Christi, see **Texas** (Climate). The city has fine facilities for fishing, sailing, and swimming, and crowds of tourists visit nearby Padre Island National Seashore. Cultural attractions in Corpus Christi include the Texas State Aquarium, the Art Museum of South Texas, the Corpus Christi Museum, and the Museum of Oriental Cultures. The city also has a symphony orchestra and Corpus Christi State University.

Oceangoing ships reach the Port of Corpus Christi via a 21-mile (34-kilometer) channel that links the city with the Gulf of Mexico. The port serves barges that use the Gulf Intracoastal Waterway, which runs along the coastline between Brownsville, Texas, and Carrabelle, Florida. Naval Station Ingleside, on northern Corpus Christi Bay, is home to U.S. Navy minehunters and minesweepers. Airlines use Corpus Christi International Airport.

Corpus Christi lies near natural gas and petroleum fields, cattle ranches, and fertile farmland. The city's chief manufactured products, in order of value, are chemicals, petroleum products, and processed foods. The Corpus Christi Army Depot is the largest employer.

History. Karankawa Indians lived in what is now the Corpus Christi area before white settlers arrived. About 1839, a trading post opened at the site to serve nearby ranchers. The settlement was named Corpus Christi probably in 1847 or 1848 and was incorporated as a city in 1852. In 1923, the city developed its first natural gas well. The city's deepwater port opened in 1926. Oil was discovered nearby in 1930. From 1920 to 1940, the city's population rose from 10,552 to 57,301.

The Corpus Christi Naval Air Station opened in 1941 and trained 40,000 naval fliers during World War II. Today, it is headquarters for the Naval Air Training Command and provides primary flight training for more than 300 pilots a year. The area's large supplies of natural gas and petroleum have attracted many industries to Corpus Christi. The population of the city grew to 167,690 by 1960 and to 257,453 by 1990. A project that dug the city's port to a uniform depth of 45 feet (13.7 meters) was completed in 1989. It improved the port's capability to handle larger ships. Terry G. Jordan

Corpuscle, *KAWR puh suhl,* in physiology, is a term used for a small mass or body. It is often used to mean *cell,* especially in referring to the red cells and white cells of the blood. Certain parts of the nervous system, such as the nerve endings in the skin that respond to pressure, are called *corpuscles.* Edward J. Shahady

Corral. See Ranching (Life on a cattle ranch).

Correggio, *kuh REHJ oh* (1489?-1534), was one of the greatest painters of the Italian Renaissance. His most important works are *frescoes* (paintings on damp plaster) on two church domes in Parma, Italy. In these paintings, Correggio created the illusion that the ceilings open into the sky and many divine figures inhabit the clouds above the viewer's head. This dramatic illusion influenced the paintings of the Baroque period of the late 1500's and the 1600's.

Correggio's early paintings of religious and mythological subjects show a delicate, graceful style. Correggio worked primarily in Parma, though his paintings suggest that he may have visited Rome during the 1500's to become more familiar with the paintings of Leonardo da Vinci and Raphael. Correggio's works show a more spirited emotional quality and dramatic handling of light than the paintings of those two masters.



Oil painting of the late 1520's; The Louvre, Paris

Correggio's *The Mystic Marriage of Saint Catherine* shows the artist's soft treatment of flesh, his command of gentle light, and his delicate handling of shading. Correggio influenced painters of the Baroque style in the 1600's.

Correggio's real name was Antonio Allegri. He took his name from the Italian town of his birth.

Eric M. Zafran

Corregidor, *kuh REHG ih DAWR,* a rocky fortified island, covers about 2 square miles (5 square kilometers) at the entrance to Manila Bay on the island of Luzon. It is sometimes called the *Gibraltar of the Pacific.* The island has a population of about 320.

Beginning in December 1941, during the early days of World War II, United States and Filipino troops made a determined stand on Corregidor against overwhelming

Japanese forces. Their surrender to enemy troops on May 6, 1942, marked the end of organized U.S. resistance in the Philippines.

The Japanese held Corregidor until U.S. troops freed Luzon in February 1945. The United States ceded Corregidor to the Republic of the Philippines in 1947. In 1954, Corregidor became a Philippine national shrine dedicated to the American and Filipino troops who died there during World War II. The island has a war museum and a marble war memorial. David J. Steinberg

Correspondence. See **Letter writing.**

Correspondence school is an educational institution that furnishes home-study material through the mail. Nearly 5 million persons are enrolled in more than 700 home-study schools in the United States. About 75 percent of the courses are of the vocational type.

Colleges and universities provide correspondence courses for nearly 400,000 people. They coordinate their programs through the National University Continuing Education Association (NUCEA). Government agencies, the armed forces, religious institutions, and business and industry provide courses for over 1,700,000 people.

Nearly 1,500,000 people are enrolled in private home-study schools. The National Home Study Council was organized in 1926 by a group of home-study schools. It works with the National Commission on Accrediting and the Federal Trade Commission to maintain sound educational standards and business practices. The 110 accredited schools in the council have an enrollment of about 1,200,000 people.

The University Extension movement in England first used the correspondence plan in 1868. The earliest U.S. practical courses were developed in the early 1890's by President William Rainey Harper of the University of Chicago. The Blackstone School of Law in Chicago, and the International Correspondence Schools in Scranton, Pa., founded in 1891, are pioneer correspondence schools still in existence. Douglas Clifford Smith

See also **Extension programs.**

Correspondent. See **Foreign correspondent; War correspondent.**

Corrosion, *kuh ROH zhuhn,* is the destruction of a material caused by the chemical action of a gas or liquid. Corrosion occurs chiefly in metals, but it may also affect ceramics. Rust is the most familiar form of corrosion. This reddish-brown substance forms on iron and steel that are exposed to moist air or to water containing impurities. See **Rust.**

In most cases, corrosion involves two related chemical reactions—*oxidation* and *reduction.* In oxidation, the atoms of a metal give up electrons to a liquid or a gas. In reduction, part of the same metal or an adjoining metal captures these electrons from the liquid or gas. The electrons that flow from one metal to the other form an electric current. In this sense, corrosion is an *electrochemical process* (see **Electrochemistry**).

There are many types of corrosion. One kind, called *localized attack,* occurs on small areas of bare metal and produces holes or cracks. Another type, *uniform corrosion,* attacks much larger areas, such as the surface of an aluminum pot or a copper roof. It can be beneficial. On copper roofs, for example, such corrosion produces a thin, greenish film called *patina* that protects the surface against further rapid corrosion.



© Guy Gillette, Photo Researchers, Inc.

Uniform corrosion is a common type of corrosion that attacks large areas. It produces a greenish film known as *patina* when it occurs on such a surface as a copper roof, *above.*

The type of corrosion and its severity depend on the chemical makeup of the metal and of the corrosive agent. Other major factors include stresses in the metal, the temperature of the corrosive agent, and the speed at which the agent moves against the metal. Corrosion tends to be more severe if the corrosive agent hits the metal at a high speed. If the agent contains solid particles, the corrosion is even worse and is called *erosion-corrosion.* Cathleen J. Hapeman

See also **Oxidation; Reduction.**

Corrupt practices are unethical techniques used by politicians to gain a political advantage in an election. The term is most commonly used in referring to federal and state legislation, called *corrupt practices acts,* that govern campaigns and elections. These laws prohibit such activities as bribery, ballot-box stuffing, tampering with voting machines, and threatening or impersonating voters. Many of these laws also govern party campaign finances. For example, many states have laws that limit the amount spent by candidates and parties in state and local elections.

Congress established the Federal Election Commission in 1974 following campaign finance irregularities in the 1972 presidential election. The commission enforces federal laws regulating contributions and spending for presidential and congressional campaigns.

Charles O. Jones

See also **Election campaign** (Legal changes).

Corsair. See **Pirate.**

Corsica, *KAWR sih kuh* (pop. 249,700), is a French island in the Mediterranean Sea. It lies 9 miles (14 kilometers) north of the island of Sardinia, between southeast-





WORLD BOOK maps

Corsica is a French island in the Mediterranean Sea.

ern France and northwestern Italy. Corsica's name in French, the official language, is Corse. The island makes up two of the *departments* (main administrative districts) of France. It is the birthplace of Napoleon.

Size and description. Corsica has an area of 3,352 square miles (8,680 square kilometers). Its 275-mile (443-kilometer) coastline is high and craggy and has few natural harbors. The rocky interior is covered with scrub and cut by narrow, fertile valleys. Ajaccio, Corsica's capital and largest city, is on the western side of the island beside the Gulf of Ajaccio. Bastia, the second largest city, lies on the eastern side.

Economy. Corsica has a mild climate, and crops flourish in the rich soils of the valleys. Farmers raise olives, grapes and other fruits, grains, vegetables, and tobacco. Cork, pine, oak, and chestnut trees cling to the steep slopes of the mountains. Corsicans grind chestnuts into meal to make bread. Wool for clothing comes from sheep that graze in the mountains. Along the coast, the people fish for sardines and hunt for coral. Miners quarry granite and marble in the mountains. Some iron, lead, and copper are also mined.

Corsica's main exports are wool and cheese. Its fastest-growing source of income is tourism. Tourists enjoy Corsica's climate, rugged scenery, and colorful villages.

History. Corsica was first settled about 560 B.C. by Phoenicians, who called it *Cyrnos.* It was conquered in turn by Etruscans, Carthaginians, and Romans. The Romans renamed it Corsica. Vandals captured Corsica in A.D. 469, but it was recaptured by Rome, under Justinian I, in 534. Later, Corsica was ruled by Charlemagne.

Pope Gregory VII assumed sovereignty of Corsica in 1077 and granted it to the Bishop of Pisa to control. About 300 years later, Corsica came under the control of the Italian city of Genoa. In 1768, the Genoese sold the island to the French, who lost it to the British in 1794. In 1796, Napoleon sent an expedition to Corsica to reestablish French control. France has held the island since then, except for a brief occupation by British soldiers in 1814, and the occupation by Italians and Germans during World War II. Allied forces freed the island in 1943, and it again became part of France.

During the 1970's, protests against French rule arose in Corsica. Since then, some Corsicans have called for independence from France. Others have favored greater local control over the island's government. In 1982, the French Parliament created a Corsican regional assembly. Corsican voters elect the assembly, which controls local spending and the development of the island's economy, education, and culture. William M. Reddy

Cortés, *kawr TEHZ* or *kawr TAYS,* **Hernando,** *ehr NAHN doh* (1485-1547), was a Spanish explorer who conquered what is now central and southern Mexico. His military triumphs led to 300 years of Spanish domination of Mexico and Central America.

Early life. Cortés, who was also known as Hernán or Fernando, was born into a noble family in Medellín in the province of Extremadura, Spain. He moved to Santo Domingo in the West Indies in 1504.

Cortés fought under Governor Diego Velázquez in a Cuban expedition that began in 1511. In 1518, Velázquez selected him to lead an expedition to the Yucatán Peninsula of Mexico, then a center of Maya civilization. Before Cortés could leave Cuba, Velázquez canceled the expedition, fearful of the voyage's expense and distrustful of Cortés's ambition. Cortés disobeyed and sailed for Yucatán in 1519, with more than 500 men and 11 ships.

Arrival in Mexico. Conquering Mexico took more than two years. At the start, Cortés skillfully made associations with Indian leaders, communicating through interpreters. One of these interpreters was a young Indian woman, Malintzin, also known as Malinche. The Indians of Tabasco had given her to the Spaniards as a peace offering. The Spaniards called her Marina. She became an adviser to Cortés, and she bore him a son.

From Yucatán, Cortés sailed northward along the coast of the Gulf of Mexico. He founded the first Spanish settlement in Mexico, La Villa Rica de Vera Cruz (modern-day Veracruz). He appointed a town council, which gave him the title of captain general, with authority under Spanish law to conquer Mexico.

In August 1519, Cortés marched toward Tenochtitlan (now Mexico City), the capital of the Aztec empire. Tenochtitlan had formed a union called the Triple Alliance with the neighboring cities of Texcoco and Tlacopan and had built an empire. The three cities forced other Indian villages to pay them taxes and to provide human sacrifices for their religious ceremonies. Many Indians resented the Aztec empire for its cruelty and volunteered to help Cortés defeat it. Others joined Cortés after he defeated them in battle.



Color lithograph (1800's) by an unknown artist; The Granger Collection

Hernando Cortés

Victory over the Aztec. At first, the Aztec emperor, Montezuma II, refused to meet with Cortés. But in November 1519, Montezuma allowed the Spaniards to enter Tenochtitlan. Cortés soon took Montezuma hostage and tried to rule the empire through him.

Six months later, Cortés left the city to challenge a



WORLD BOOK map

Hernando Cortés sailed from Cuba to Mexico in 1519 and conquered the Aztec Indians there in 1521. He led an expedition to Honduras from 1524 to 1526 and one to Lower California in 1535.

Spanish expedition led by Pánfilo de Narváez, who had been sent by Velázquez to arrest him. Cortés easily captured Narváez and persuaded Narváez's troops to join him. Meanwhile, the people of Tenochtitlan rebelled. Soon after Cortés returned, Montezuma was wounded and died. The Spanish soldiers fled the city.

In December 1520, Cortés began to organize an attack against Tenochtitlan and its new leader, Cuauhtémoc. The city fell on Aug. 13, 1521. When brought before Cortés, Cuauhtémoc asked to die. Cortés, believing Cuauhtémoc knew where Aztec treasures were hidden, had him tortured, but Cuauhtémoc refused to tell any secrets. In 1525, Cortés had him hanged.

After the conquest. King Charles I of Spain, who had become Holy Roman Emperor Charles V in 1519, appointed Cortés governor and captain general of the newly conquered territory. Cortés received the title Marqués del Valle de Oaxaca in 1528. He managed the founding of new cities and appointed men to extend Spanish rule to all of Mexico, which was renamed New Spain. Cortés also supported efforts to convert Indians to Christianity and sponsored new explorations. He led expeditions to Honduras in 1524 and to Baja California in northwestern Mexico in 1535 and 1536.

Cortés returned to Spain in 1540. His last battle was a Spanish attack on Algiers in 1541. Kevin Gosner

Related articles in *World Book* include:

Alvarado, Pedro de
Aztec (The Spanish conquest)
Cuauhtémoc
Indian, American (picture)
Mexico (The Spanish conquest)
Montezuma II
Tenochtitlan



Drawing with colored ink on parchment by an unknown artist; Biblioteca Apostolica Vaticana (Vatican Library)

Hernando Cortés conquered Mexico for Spain in the early 1500's. The manuscript in picture writing, *shown here,* shows Cortés meeting the Aztec ruler Montezuma in 1519. An Aztec artist created the manuscript at Montezuma's request.

Additional resources

Lilley, Stephen R. *Hernando Cortes.* Lucent Bks., 1996.
Marks, Richard L. *Cortés.* Knopf, 1993.
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Cortina, *kawr TEE nah,* **Juan Nepomuceno,** *hwahn NAY poh moo SAY noh* (1824-1894), was an early leader of the civil rights struggle of Mexican Americans. He fought the unfair treatment received by Mexican Americans in Texas following the Mexican War (1846-1848). Cortina became a Mexican folk hero and was called the "Robin Hood of South Texas."

Cortina was born near Brownsville, Texas, when Texas was part of Mexico. As a young man, he became angry at the attempts of English-speaking Americans to deprive Mexican Americans of their property. Many Mexican Americans did not understand United States property laws. Those who did not register their land with the state or pay property taxes lost their land. Most courts did not protect the rights of Spanish-speaking people.

In September 1859, Cortina led about 100 men in a raid on Brownsville. His band killed three men who had abused Mexican Americans. Cortina led other raids in Texas until U.S. troops chased him into Mexico in 1860. From 1869 to 1876, Cortina served as governor of the Mexican state of Tamaulipas. He also became a brigadier general in the Mexican Army. Feliciano M. Ribera

Cortisone, *KAWR tuh zohn,* is one of an important group of hormones made in the *cortex* (outer part) of the adrenal glands. These compounds, called *corticosteroids,* are essential for life. They play an important part in regulating salt and sugar balances in the body. These compounds help the body adjust to environmental changes and other kinds of stress.

Scientists synthetically produce corticosteroids for use as drugs. The drugs reduce inflammation. Physicians use them in treating arthritis, some kinds of cancer, eye and skin disorders, and many other diseases. Patients who undergo a transplant operation may receive corticosteroids. The drugs lower the body's natural immune defenses and help it accept the transplanted organ. Doctors also prescribe the drugs for people whose glands produce too little of the natural compounds.

Cortisone and other corticosteroids can cause serious—even fatal—side effects and thus must be used carefully. Side effects include swelling of body tissues, changes in behavior, ulcers, weakness of the bones and muscles, and an increased probability of developing infections. Prolonged treatment may also cause the adrenal glands to temporarily stop producing natural corticosteroids. In such cases, withdrawal from the drugs must take place gradually to allow the glands to recover.

Biochemists isolated and determined the chemical structure of cortisone and many other corticosteroids during the 1930's and 1940's. In 1948, cortisone became the first of these compounds to be used as a drug on human patients. N. E. Sladek

See also **ACTH; Gland; Hormone; Julian, Percy L.**

Corundum, *kuh RUHN duhm* (chemical formula, Al_2O_3), is the second hardest pure mineral. Only diamond is harder. Corundum occurs as transparent nuggets in gravel, and as nontransparent grains and rare transparent crystals in rocks.

Varieties of transparent corundum are polished and

used as gemstones. Gemstones from corundum include the ruby, sapphire, Oriental amethyst, Oriental emerald, and Oriental topaz. The colors of the gemstones are caused by impurities in the corundum. For example, the red of the ruby is caused by the presence of traces of chromium, and the blue of the sapphire by iron and titanium. Gemstone corundum comes mainly from Australia, southeast Africa, India, Myanmar, and Sri Lanka.

Nontransparent corundum is used as an *abrasive* (grinding, smoothing, and polishing material). Emery, a common abrasive, is a natural mixture of corundum and other minerals. Abrasive quality corundum and emery are mined in Turkey and Greece. David F. Hess

Related articles in *World Book* include:

Amethyst	Emery	Hardness	Sapphire
Emerald	Gem	Ruby	Topaz

Cosby, Bill (1937-), is a leading American entertainer, author, and TV producer. He is noted for his warm, gentle humor, which centers on the family and the trials and troubles of childhood. His television series *The Cosby Show* ran from 1984 to 1992. It ranked as one of the most popular television shows in the United States.



© Michael Virden, Shooting Star
Bill Cosby

William Henry Cosby, Jr., was born in Philadelphia. He began his show-business career as a nightclub comedian and has since recorded over 20 comedy albums. He starred in several motion pictures, including *Hickey and Boggs* (1972) and *Uptown Saturday Night* (1974). Cosby was the first black actor to co-star in a prime-time TV dramatic series. This series, *I Spy,* ran from 1965 to 1968. Another success came in 1972 when he became executive producer and host of the TV cartoon series *Fat Albert and the Cosby Kids,* based on one of his most famous comic characters.

Cosby is also an author. He has written *Fatherhood* (1986), a book of humorous essays; *Time Flies* (1987), a book about aging; and *Love and Marriage* (1989), which deals with romantic relationships. Joe Robinowitz

Cosimo de' Medici. See Medici, Cosimo de'.

Cosmetic surgery. See Plastic surgery.

Cosmetics are substances applied to a person's body to cleanse, promote attractiveness, or alter the appearance. Cosmetics include underarm deodorants, face powder, lipstick, nail polish, perfume, skin creams, most shampoos, and some toothpastes.

More than 5,000 ingredients are used in the manufacturing of cosmetics. These ingredients include alcohols, alkalis, detergents, dyes, glycerol, oils, talc, and waxes. A person who manufactures or sells cosmetics, or who applies them to others, is called a *cosmetician.* The study of cosmetics and their uses is called *cosmetology.*

Kinds of cosmetics. Most cosmetics can be classified into four main groups, according to the part of the body for which they are used: (1) skin, (2) hair, (3) nails, and (4) mouth.

Skin cosmetics include such makeup as blushes, rouge, face powder, foundations, and lipstick. Also in this group are eyeliners, eye shadow, and mascara, as well as bubble baths, cold cream, underarm deodorants, foot powder, hair-removal substances, perfume, shaving cream, moisturizers, and suntan lotion.

Hair cosmetics include hair conditioners, mousses, sprays, styling lotions, straighteners, and permanent waves. Such hair-coloring products as dyes and bleaches are also hair cosmetics, as are shampoos that do not contain antidandruff ingredients.

Nail cosmetics. Nail polish and cuticle softeners are the chief products in this group.

Mouth cosmetics, also called *oral cosmetics,* include toothpastes and other substances that clean the teeth and gums but do not have cavity-fighting ingredients. Mouthwashes and sprays are also oral cosmetics.

Other cosmetics. Performers in motion pictures, television, theater, and circuses wear special cosmetics that must withstand the heat from powerful lights without melting or running. Many people use special medicinal cosmetics to conceal birthmarks, scars, or other skin blemishes.

Cosmetics regulations. The Food and Drug Administration (FDA), an agency of the federal government, regulates cosmetics in the United States. The agency requires that cosmetics be safe and properly labeled. It tests products to determine if unsafe ingredients are present, and it inspects cosmetics factories. The FDA requires cosmetics manufacturers to list on each package the names of the ingredients used in the product, in order of descending concentration.

The FDA classifies as a cosmetic any product whose sole purpose is to improve a person's appearance. If a product also is intended to prevent disease or to affect any body structure or function, the FDA considers it a drug.

History. Men and women have used cosmetics for thousands of years. The ancient Egyptians applied perfumes and anointing oils to the body as early as 4000 B.C. They used these cosmetics for decoration, for protection against the hot, dry climate, and for religious reasons. The Egyptians, Greeks, and Romans made cosmetics from plants. They also used powdered minerals to make face and eye makeup and hair dyes.

By the A.D. 1100's, the use of cosmetics had spread to Western Europe. Africans of about the same period painted their bodies for war and for magical ceremonies. In North America, the first cosmetics were animal fats that were used by Indians long before Europeans arrived. The Indians applied these substances not only as a base for body paint but also as protection against insects and the cold.

By the early 1900's, most people used only such basic cosmetics as face powder, rouge, and shampoos. Demand for a wider variety of cosmetics grew tremendously after the 1930's, as did widespread advertising and promotion of these products. Clarence R. Robbins

See also Depilatory.

Cosmic rays are electrically charged, high-energy particles that travel through outer space. They are *subatomic particles,* units of matter smaller than an atom. Astronomers believe that cosmic rays fill our Milky Way Galaxy and other galaxies.

Scientists study cosmic rays because these particles

are the only matter that reaches the earth from outside the solar system. Studies of cosmic rays reveal conditions in *interstellar space* (space between the stars). Scientists also learn about processes that occur when a star explodes as a *supernova.*

Physicists measure the energy of cosmic rays in units called *electronvolts* (eV). One electronvolt is the energy needed to move an electron between two points with a potential difference of 1 volt (see **Volt**). Most cosmic rays have energies between a few million and a few billion electronvolts. One million electronvolts is abbreviated 1 MeV, and 1 billion electronvolts is abbreviated 1 GeV. A proton with 1 GeV of energy can go through almost 2 feet (60 centimeters) of iron.

There are two kinds of cosmic rays: (1) *primary cosmic rays,* or *primaries,* which originate in outer space; and (2) *secondary cosmic rays,* or *secondaries,* which originate in the earth's atmosphere. Secondaries form when primaries collide with atoms at the top of the atmosphere. The collision changes the primary and the atom into a shower of secondaries. Many secondaries then collide with other atoms, making more secondaries.

Some secondaries reach the surface and even penetrate deep into the ground. No measurable amount of primaries reaches the earth's surface.

Primary cosmic rays

Primary cosmic rays move through space at almost the speed of light, which is 186,282 miles (299,792 kilometers) per second. Most primaries that reach the earth's atmosphere have traveled through the Milky Way for millions of years.

There are three main types of primary cosmic rays: (1) galactic, (2) solar, and (3) anomalous component. *Anomalous component* means *peculiar part of a group.* Physicists gave anomalous component primaries this name when they were discovered in the early 1970's. The composition and behavior of these particles differed greatly from those of galactic and solar primaries, which had been identified by the late 1950's.

Galactic cosmic rays come from outside the solar system. Most primaries are galactic cosmic rays. About 98 percent of galactic cosmic rays are atomic nuclei, which carry a positive electric charge. About 87 percent of the nuclei are single protons—nuclei of hydrogen atoms. Roughly 12 percent are helium nuclei, each consisting of two protons and two electrically neutral particles called *neutrons.* The remainder include nuclei of all chemical elements heavier than helium.

The 2 percent of primaries that are not nuclei are electrons, which are negatively charged, and *positrons.* A positron is the antiparticle of an electron. A positron has the same *mass* (amount of matter) as an electron but carries a positive charge.

Energy sources. Scientists believe that galactic cosmic rays get their energy from shock waves produced by supernovae or from strong *magnetic fields* around *neutron stars.* A magnetic field is a region where magnetic forces can be felt. A neutron star is an extremely dense, rapidly rotating star that remains after some supernova explosions. Galactic primaries may also gain energy from weaker waves that travel along the weak magnetic fields of interstellar space.

The most powerful source of energy is supernova shock waves. However, the highest-energy primaries have more energy than even a supernova can provide. Scientists do not know how these particles get their extra energy.

Magnetic control. Magnetic fields control the travel of cosmic rays through space. A magnetic field can be thought of as a set of imaginary lines extending through space. No field line crosses another. In outer space, where magnetic fields are weak, a field line may be stretched many trillions of miles from its source. It is often not clear where these fields originate. See **Magnetism** (illustration: A magnetic field).

If a primary—or any other electrically charged object—moves across a field line, the field bends the path of the object at a right angle to the object's original path. Charged particles therefore can move easily along a magnetic field but have difficulty traveling very far across a field.

The travels of primary cosmic rays. After receiving their energy, primaries travel randomly along magnetic fields in the galaxy for an average of 10 million to 20 million years. Because of the randomness of this motion, the direction from which a primary comes gives scientists no indication of the source of the primary.

Some cosmic rays eventually leave the galaxy. Others strike so much interstellar matter that they lose almost all their speed and become particles of interstellar matter themselves.

Solar effects. A magnetic field carried by the *solar wind* prevents some galactic cosmic rays from entering the solar system. The solar wind is a continuous stream of *ions* (electrically charged atoms) flowing from the sun, typically at speeds of about 250 miles (400 kilometers) per second or more. These ions have too little energy—only about 1,000 eV—to be cosmic rays.

Activity on the surface of the sun disturbs the solar wind. Sunspots are one sign of solar activity (see **Sunspot**). The solar activity increases and decreases in an 11-year cycle called the *sunspot cycle.* As activity increases, the flow of the solar wind becomes more disturbed and the magnetic field therefore becomes more complicated. As a result, the primary cosmic rays have more difficulty reaching the earth. During a sunspot cycle, the number of galactic primaries striking each square inch (6 square centimeters) of the top of the atmosphere ranges from two to six per second.

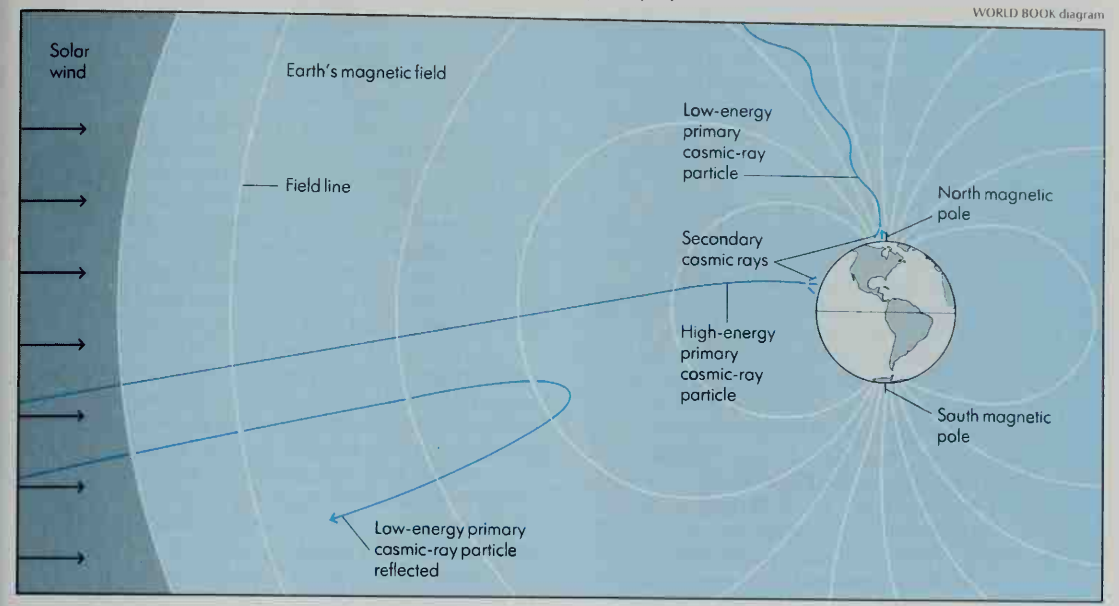
Solar cosmic rays are produced by the sun during solar flares and other spectacular eruptions on the sun's surface. Solar flares occur mainly during periods of high activity in the sunspot cycle. Most solar cosmic rays are protons with energies of only a few MeV. However, large flares can produce particles with energies up to a few GeV. Heavier nuclei and electrons also occur in solar cosmic rays.

Anomalous component cosmic rays develop from normal atoms in interstellar gas near the sun. Because they have no electric charge, the atoms pass freely through the solar wind and its magnetic field. Close to the sun, some atoms absorb so much energy from the sun's ultraviolet radiation that an electron leaves each of them. Because electrons carry a negative charge, each atom that loses an electron becomes a positive ion. Almost all ions produced in this manner are ions of hydrogen, helium, nitrogen, oxygen, and neon.

How cosmic rays penetrate the earth's magnetic field

Primary cosmic-ray particles, even those with low energies, can enter the earth's atmosphere near the poles by traveling along the field lines of the magnetic field. Only particles with extremely high energies can cut across the field lines and reach the atmosphere near the equator. The magnetic field there reflects most particles, including many with high energies. Secondary cosmic rays are created in the atmosphere by collisions between the primary rays and atomic nuclei.

WORLD BOOK diagram



The solar wind picks up the new ions and carries them to the edge of the *heliosphere,* the huge region of space filled by the solar wind. The heliosphere extends beyond the orbits of all the planets.

Scientists believe that there is a shock wave at the edge of the heliosphere where the solar wind runs into interstellar material and slows down. This shock wave can accelerate ions to energies of hundreds of MeV.

After they are accelerated, the ions can re-enter the heliosphere as anomalous component cosmic rays. During low points in the sunspot cycle, there are more anomalous component primaries than galactic primaries in the heliosphere at energies below about 100 MeV.

Anomalous component primaries are too weak to produce many secondaries. Scientists therefore did not discover them until the early 1970's, when spacecraft carried instruments that could detect them.

Secondary cosmic rays

Secondary cosmic rays include all types of subatomic particles. Most secondaries are *muons,* which are similar to electrons, but more massive. Physicists discovered many types of subatomic particles in secondary cosmic rays before building machines called *particle accelerators* to study high-energy particles.

Secondaries slow down in the atmosphere. Only a small fraction of them reach the earth. Every minute, about six secondaries strike each square inch of the earth. Because of the earth's magnetic field, the concentration is lower near the equator than near the poles.

Effects of cosmic rays

Cosmic rays do not produce enough radiation on the earth to harm living things. Above the atmosphere, however, the radiation reaches harmful levels. It is extremely dangerous in the *Van Allen belts,* regions that contain large numbers of particles. The radiation can also be dangerous anywhere above the atmosphere during solar flares.

Galactic primaries consisting of heavy nuclei have caused problems in electronic circuits that are on spacecraft. If a heavy nucleus hits an ordinary computer chip, the chip may stop operating properly. As a result, engineers have developed chips that are less sensitive to cosmic rays.

Cosmic rays also produce *radiocarbon* in the atmosphere. Radiocarbon, or carbon 14, is a radioactive form of carbon. Scientists can use it to determine the age of ancient materials and to study solar activity. See **Radiocarbon**.

Cosmic ray research

During the late 1800's, physicists used *electroscopes* to study radioactivity. An electroscope stores electric charge and indicates the presence of the charge. Exposure to high-energy radiation causes a charged electroscope to lose its charge. Even when the electroscopes were shielded from the most powerful rays known to be given off by radioactive substances, they showed that radiation was still present.

In 1912, the Austrian physicist Victor F. Hess took some electroscopes up in a balloon. He showed that the mysterious radiation increased with altitude. Hess concluded that the radiation must originate in the upper atmosphere or beyond. In 1936, he received the Nobel Prize for physics for discovering cosmic rays.

By the late 1950's, scientists had used many types of instruments on the ground and in balloons to determine

that cosmic rays are electrically charged particles and that they consist mostly of hydrogen and helium nuclei. Researchers had also discovered that solar activity affects the intensity of cosmic rays.

Since the 1960's, scientists have used balloons and spacecraft to study low- and medium-energy primaries. They have used large instruments on the ground to study secondaries. Space probes beyond the outer planets continue to provide information on how the heliosphere affects cosmic rays. R. B. McKibben

See also **Heliosphere; Sun** (Particle radiation); **Van Allen belts.**

Cosmology. See **Philosophy** (Metaphysics).

Cosmology, *kahz MAHL uh jee,* in astronomy, is the study of the structure and development of the universe and the forces that work on it. Cosmologists try to explain how the universe formed, what has happened to it since, and what might happen to it in the future.

Five observations have contributed much to modern cosmology: (1) the sky is dark at night; (2) galaxies move away from one another; (3) the entire sky gives off radio waves; (4) helium is abundant in the universe; and (5) the age of the oldest stars is 10 billion to 20 billion years.

The dark sky. During the 1700's and 1800's, astronomers wondered why the sky is dark at night. In the simplest universe they could imagine, stars would be distributed evenly throughout an infinite space. The entire night sky would therefore appear to be a solid mass of stars as bright as the sun. The inconsistency between this imaginary sky and the actual dark sky indicates that the universe has a complex structure. This inconsistency has been named *Olbers's paradox* after its author, German astronomer Heinrich Olbers.

Movement of galaxies. In the early 1900's, astronomers analyzed light from stars in distant galaxies. They passed this light through a prism, which broke it up into a rainbowlike band of colors called a *spectrum* (plural *spectra).* At one end of the spectrum of visible light is red, the color with the longest *wavelength* (distance between successive wave crests). At the other end is violet, which has the shortest wavelength. The spectrum of light sent out by any star has bright and dark lines that indicate the composition of the star's outer layers and atmosphere.

The astronomers then compared the spectra of the light from the stars in the distant galaxies with spectra of similar stars in our home galaxy, the Milky Way. They discovered that the spectral lines of the distant stars are closer to the red end of the spectrum than are the corresponding lines in the light from our neighboring stars. The astronomers concluded that this *redshift* is caused by the distant galaxies moving rapidly away from the Milky Way. Calculations of the speeds of various galaxies indicate that the universe is expanding and that all galaxies began moving away from one another 10 billion to 20 billion years ago.

Radio waves in space. In 1965, astronomers detected faint radio waves throughout the sky. The waves are similar to waves that would have been received from an extremely hot object moving rapidly away from the earth. The discovery of the radio waves thus reinforced the idea that the universe is expanding. The waves are also evidence for the *big bang,* a hot, explosive beginning of the universe 10 billion to 20 billion years ago.

Abundant helium. About 76 percent of the mass of the universe is hydrogen, 24 percent is helium, and the remaining small fraction of 1 percent consists of all other chemical elements. Stars make helium nuclei by *fusing* (joining) hydrogen nuclei in their hot cores. But the universe has not existed long enough for stars to have produced a 24 percent concentration of helium. Thus, the universe as a whole must once have been extremely hot and dense.

Star ages. Astronomers have calculated the age of the oldest stars in the Milky Way. These stars reside in groups called *globular clusters.* All the stars in a globular cluster form at about the same time. Clusters that are relatively old have a higher proportion of old stars called *red giants* than do younger clusters. Thus, by analyzing the light from clusters, astronomers have been able to calculate the ages of the oldest stars. The calculations indicate that the stars in the oldest globular clusters are 12 billion to 16 billion years old.

The future of the universe. Astronomers have developed *models* (mathematical descriptions) that represent the universe as expanding, contracting, *oscillating* (expanding then contracting), or *static* (neither expanding nor contracting). The universe is presently expanding, but its distant future depends on its present density.

Suppose all the matter detected to date is all that exists. There would be an average of about one atom of hydrogen in 1 cubic yard (0.76 cubic meter) of space. The universe would be *open.* It would continue to expand without limit. Eventually, all stars would exhaust the energy that makes them shine.

But suppose the universe contains large amounts of *dark matter,* material that has not yet been detected. If the average density of matter in space were as much as 10 atoms of hydrogen per cubic yard, the universe would be *closed.* In perhaps 20 billion to 40 billion years, the expansion would stop. The galaxies would then start to come together again, and matter would approach infinite density. This collapse might be followed by another period of expansion, and so on without limit.

Other theories. Some scientists think there was no big bang. According to the *steady state* theory, matter is continuously created. The new matter forms galaxies, replacing galaxies that move to infinite distances. Other scientists suggest that the big bang theory is basically correct, but that the universe underwent an early period of rapid expansion called *inflation.* Kenneth Brecher

See also **Big bang; Universe.**

Cosmonaut. See **Astronaut.**

Cosmos, *KAHZ muhs,* are tall, late-summer flowers native to Mexico and the American tropics. Their flowers range from white and pink to red and orange, and may be double or single. Seeds may be planted outdoors after the ground warms, or they may be planted indoors in early spring and then transplanted a few weeks before summer. Cosmos are well adapted to full sun, and to light soil that is not too rich. They make good background plants or fillers among shrubs, and provide excellent cut flowers. Michael J. Tanabe

Scientific classification. Cosmos belong to the composite family, Asteraceae or Compositae. They make up the genus *Cosmos.* The scientific name for the familiar garden plants is *C. bipinnatus.*

See also **Flower** (picture: Garden annuals).

Cossacks, *KAHS aks,* were a group of elite cavalry warriors in Ukraine and Russia. They became famous for their riding and their fierce independence.

In the 1400's and 1500's, most Cossacks were peasants who had fled into unsettled plains of what are now southern Ukraine and western Russia to escape serfdom or to gain more independence. There, they established self-governing communities. The rulers of Poland and Russia asked the Cossacks to defend their lands against raids by Asian invaders called Tatars.

The Ukrainian Cossacks began a rebellion against Poland in 1648. Tens of thousands of Jews were killed in the rebellion. The Jews had been associated with Polish rule because many held such positions as overseers or tax collectors for Polish landowners. As a result of the rebellion, Cossack rule spread over much of Ukraine. In 1654, the Ukrainian Cossacks formed an association with the *czar* (emperor) of Russia. They served in the Russian army until the late 1700's.

The Russian Cossacks played a key role in expanding the Russian empire in the middle and late 1800's, especially in Siberia. They supported the czars with fierce loyalty and served in Russia's army. By 1916, Cossack communities had almost $4\frac{1}{2}$ million people.

Cossacks formed the basis of the forces that fought the Bolsheviks in the civil war that followed the Russian Revolution of 1917. After the Bolsheviks gained control of Russia and formed the Soviet Union in 1922, they broke up the Cossacks as a distinct group. After the Soviet Union collapsed in 1991, the Cossacks reemerged. They created their own political and social organizations and formed volunteer military units. Orest Subtelny

Cost. See Price.

Cost-benefit analysis, also called *benefit-cost analysis,* is a type of economic study that measures the costs and benefits to society of existing or proposed programs. Government and industry planners use cost-benefit analyses to help them make decisions.

Cost-benefit analysts focus on a clearly stated proposal, such as plans to create a park or to extend a highway system. They try to determine the effects of the proposal on as large a number of people as possible. Analysts formulate their estimates of costs and benefits in terms of dollars or other currencies. If the program produces economic benefits that exceed the cost of putting it into action, the program is judged to be worthwhile. Projects that produce such economic benefit are called *cost-effective.*

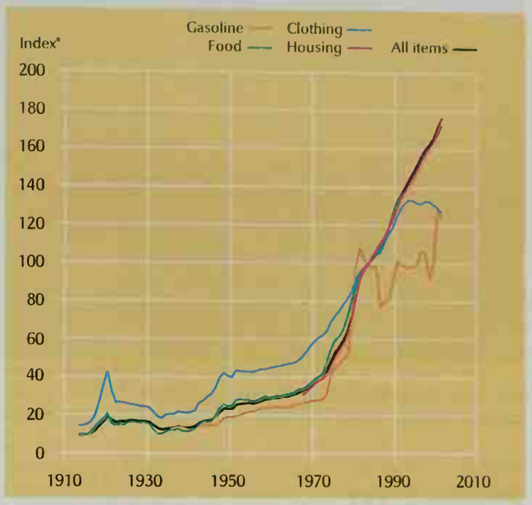
Stating costs and benefits in monetary terms poses a problem for analysts. Some factors, such as labor and materials, have measurable market prices. But other factors, such as the beautification of an area or increasing safety, have no market price. Cost-benefit analysts therefore must estimate a value called a *shadow price* for these factors.

Analysts also have the problem of studying policies that affect people for many years. A delay in receiving something generally lowers its current value. Analysts calculate this lower value through a procedure called *discounting.* Analysts often calculate the ratio between the discounted value of benefits and the discounted value of costs. If this ratio is greater than one, the project is considered economically worthwhile.

Robert H. Haveman

Cost of living in the United States

The Consumer Price Index (CPI) measures the cost of living. Current prices of goods and services are expressed as a percentage of average prices during the period from 1982 to 1984. An index of 177.1 means the average price level was 77.1 percent higher than the average price level in the 1982 to 1984 period. This graph shows the CPI for selected items in the United States.



*Base period: Average for 1982 through 1984 = 100.
Source: U.S. Bureau of Labor Statistics.

Cost of living is the amount of money needed to buy a standard amount of consumer goods and services. Needs of individual persons and families vary. Everyone needs food, clothing, and shelter, but wants go beyond these bare necessities. The cost of living includes the cost of transportation, reading, recreation, rent, electric power, gas, fuel, home furnishings, medical and personal care, taxes, and many other things.

When salaries and wages keep step with the prices of consumer goods and services, the worker's buying power remains stable. When prices rise, people with fixed incomes, such as pensions, fall behind in buying power. Changes in the cost of living have many causes. For example, when spending on consumer goods rises faster than the nation's ability to produce them, prices tend to go up. But when more goods than money are available, prices go down.

The Bureau of Labor Statistics, an agency of the United States government, collects and analyzes data on employment, wages, and productivity. It also collects data to measure changes in the prices of consumer goods and services. It publishes a Consumer Price Index that summarizes this information. In preparing the Consumer Price Index, the Bureau of Labor Statistics collects information on prices and costs from thousands of food stores, homeowners and tenants, and other sources.

A system called *indexing* or *indexation* is used to tie prices, wages, and taxes to the rate of inflation. Indexing provides for automatic increases and decreases in prices, wages, and taxes as the official cost-of-living index rises and falls. For example, many U.S. labor contracts have an *escalator clause,* which automatically lifts wages as the Consumer Price Index rises. Henry J. Aaron

See also Consumer Price Index; Deflation; Inflation.



© Stuart Cohen, The Stock Market

San José, Costa Rica's capital and largest city, lies on a plateau in the agricultural center of the country. Modern stores and office buildings stand among Spanish-style churches and houses.

Costa Rica

Costa Rica is a small, mountainous country in Central America. It is bordered by Nicaragua on the north, the Caribbean Sea and Panama on the east, and the Pacific Ocean on the south and west. A chain of rugged mountains stretches across central Costa Rica from northwest to southeast. A few of the highest peaks in this chain are active volcanoes. Tropical forests grow on the country's coastal lowlands.

Spanish explorers arrived in what is now Costa Rica in the early 1500's. Rumors that deposits of gold and other precious metals were supposedly mined in the region led the Spaniards to name the land *Costa Rica,* which means *rich coast.* But the explorers found that the area had little mineral wealth.

Today, about three-fourths of Costa Rica's people live on a fertile plateau in the mountains of central Costa Rica. San José, the capital and largest city, lies in this region. Hillsides covered with coffee trees surround San José. Coffee is one of the country's chief exports. Bananas, another major export, grow on large plantations near the coasts. Computer chips, manufactured near San José, became one of Costa Rica's leading exports in the late 1990's.

Government

Costa Rica is a democratic republic. Its Constitution was adopted in 1949. A president serves as the nation's chief executive and head of state. The people elect the president to a single four-year term. The president, two vice presidents, and the members of the Cabinet make up the Council of Government. The council carries out the day-to-day operations of the government.

The Legislative Assembly is Costa Rica's legislature. It has 57 deputies elected by the people to four-year terms. The deputies may not be elected to two terms in a row. The Supreme Court of Justice, the nation's highest court, has 17 justices appointed by the legislature.

Costa Rica's army was abolished in 1948. But military forces may be organized for national defense if necessary.

Costa Rica has seven provinces. The provinces are divided into 80 *cantons* (counties). Each province has a governor who is appointed by the president. A council

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Facts in brief

Capital: San José.
Official language: Spanish.
Official name: República de Costa Rica (Republic of Costa Rica).
Area: 19,730 mi^2 (51,100 km^2). *Greatest distances*—north-south, 220 mi (354 km); east-west, 237 mi (381 km). *Coastline*—380 mi (612 km) on the Pacific Ocean; 133 mi (214 km) on the Caribbean Sea.
Elevation: *Highest*—Chirripó Grande, 12,530 ft (3,819 m) above sea level. *Lowest*—sea level along the coasts.
Population: *Estimated 2002 population*—4,188,000; density, 212 per mi^2 (82 per km^2); distribution, 55 percent rural, 45 percent urban. *1984 census*—2,416,809.
Chief products: *Agriculture*—bananas, beef cattle, cacao, coffee, corn, rice, sugar cane. *Manufacturing*—cement, computer microchips, furniture, machinery, processed foods, textiles.
National anthem: "Noble Patria, Tu Hermosa Bandera" ("Noble Homeland, Your Beautiful Flag").
Money: *Basic unit*—colón. One hundred centimos equal one colón.

elected by the people governs each canton. The cantons provide fire protection, sanitation, water, and other local services.

All citizens 18 years or older are required to vote in national elections. Costa Rica has two major political parties, the National Liberation Party and the Social Christian Unity Party. The country also has several minor parties.

People

Costa Ricans take great pride in their country's heritage of democratic government and social equality. They also value their own personal dignity and strong family ties.

Nearly all Costa Ricans speak Spanish, but many blacks still speak a Jamaican *dialect* (local form) of English. About 90 percent of the people belong to the Roman Catholic Church.

San José is the capital and largest city of Costa Rica. Other large cities in the country include Desamparados and Limón.

Ancestry. Many Spanish colonists who settled in Costa Rica in the 1500's and 1600's married native Indians. Their descendants are called *mestizos*. Today, mestizos and whites of unmixed ancestry make up more than 97 percent of the population.

Costa Rica also has two small minority groups—about 70,000 blacks and about 10,000 Indians. The blacks live along the Caribbean coast. Their ancestors came to Costa Rica from the island of Jamaica during the late 1800's to build railroads and to work on the banana plantations.

The Indians live in isolated communities located in the highlands and along the Caribbean and Pacific shores. The Indians keep their tribes' traditional ways of life.

Housing. Many of Costa Rica's farmers live in brightly painted wooden houses. Other farmers live in adobe cottages with thick, white stucco walls and red- or pink-tiled roofs. Most of the country's city people live in *row houses,* which look alike and are attached to one another in a row. Many Costa Ricans decorate their homes with plants and flowers. Wealthy families own spacious ranch-style or Spanish-style homes surrounded by gardens.



R. Lyon, Alpha Photo Assoc.

An open-air market in Cartago is jammed on Sundays with shoppers who buy produce from farmers. The woman in the foreground is selling tickets for Costa Rica's national lottery.

Food. The diet of most Costa Ricans includes beans, coffee, corn, eggs, rice, squash, and such tropical fruits as bananas, guavas, mangoes, oranges, and pineapples. Most Costa Rican families also serve beef, fish, poultry, and many kinds of soups. Costa Ricans often prepare *tamales* (ground pork and corn meal steamed in banana leaves) and *tortillas* (thin flat bread made from corn flour).

Education. Most of Costa Rica's people can read and write. For the country's literacy rate, see **Literacy** (table: Literacy rates for selected countries).

Costa Rican law requires all children to complete elementary school. Students who graduate may attend secondary school and then enter a university. The country has several universities, including the National University in Heredia and the University of Costa Rica near San José.

Recreation. Costa Ricans enjoy spending their leisure time outdoors. Many of them play soccer, the national sport, in neighborhood fields. Basketball, tennis, and swimming are also popular. Many Costa Ricans take



WORLD BOOK map

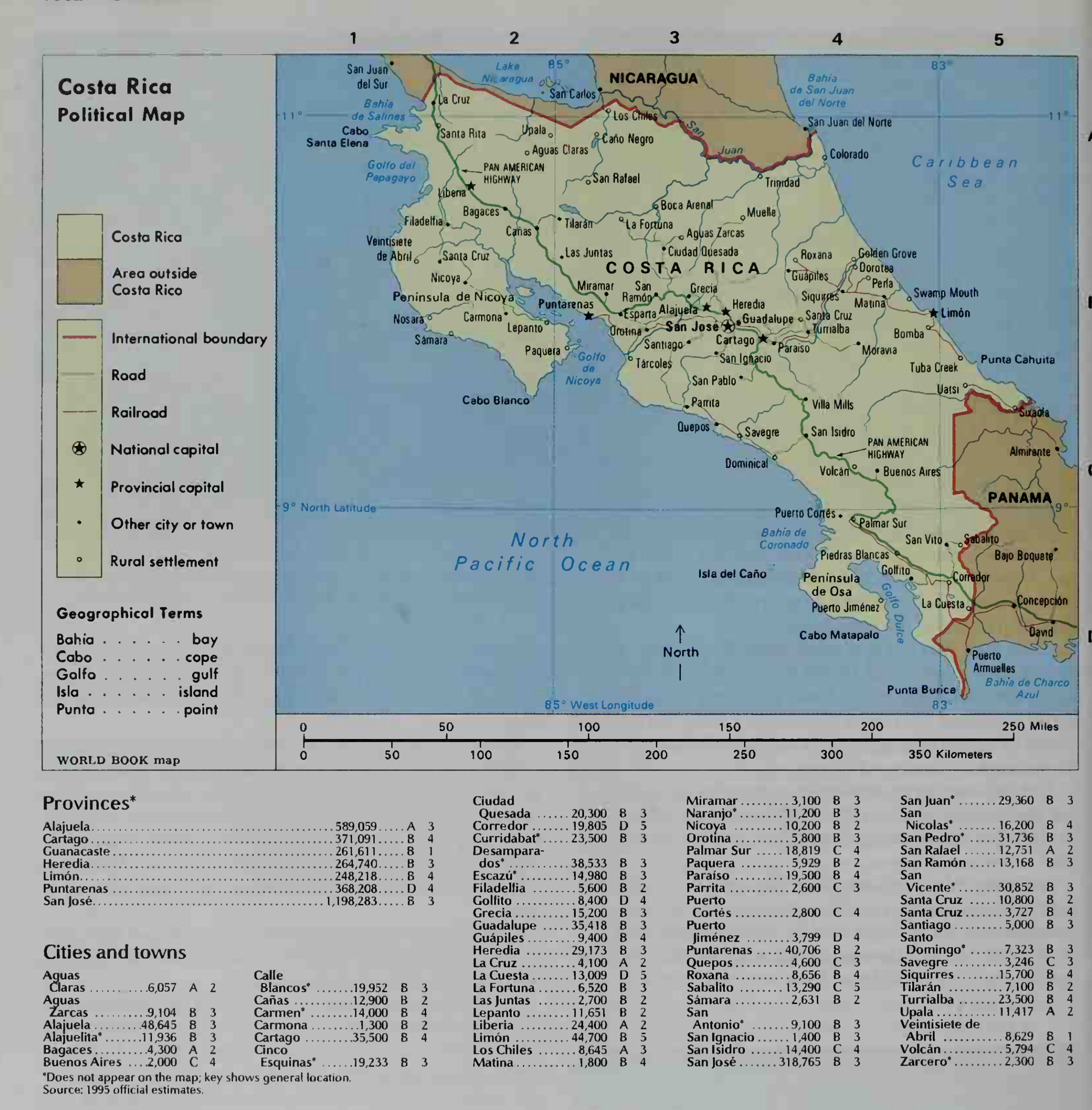
Costa Rica is a Central American country that lies between the Caribbean Sea and the North Pacific Ocean.



Costa Rica's state flag, used by the government, was adopted in 1848. The national flag has no coat of arms.



The coat of arms shows volcanoes, the Caribbean Sea, and the Pacific Ocean. Each star represents a province.



Provinces*

Province	Population	Map key	
Alajuela	589,059	A	3
Cartago	371,091	B	4
Guanacaste	261,611	B	1
Heredia	264,740	B	3
Limón	248,218	B	4
Puntarenas	368,208	D	4
San José	1,198,283	B	3

Cities and towns

City or town	Population	Map key	
Aguas Claras	6,057	A	2
Aguas Zarcas	9,104	B	3
Alajuela	48,645	B	3
Alajuelita*	11,936	B	3
Bagaces	4,300	A	2
Buenos Aires	2,000	C	4
Calle Blancos*	19,952	B	3
Cañas	12,900	B	2
Carmen*	14,000	B	4
Carmona	1,300	B	2
Cartago	35,500	B	4
Cinco Esquinas*	19,233	B	3
Ciudad Quesada	20,300	B	3
Corredor	19,805	D	5
Curridabat*	23,500	B	3
Desamparados*	38,533	B	3
Escazú*	14,980	B	3
Filadelfia	5,600	B	2
Golfito	8,400	D	4
Grecia	15,200	B	3
Guadalupe	35,418	B	3
Guápiles	9,400	B	4
Heredia	29,173	B	3
La Cruz	4,100	A	2
La Cuesta	13,009	D	5
La Fortuna	6,520	B	3
Las Juntas	2,700	B	2
Lepanto	11,651	B	2
Liberia	24,400	A	2
Limón	44,700	B	5
Los Chiles	8,645	A	3
Matina	1,800	B	4
Miramar	3,100	B	3
Naranjo*	11,200	B	3
Nicoya	10,200	B	2
Orotina	5,800	B	3
Palmar Sur	18,819	C	4
Paquera	5,929	B	2
Paraíso	19,500	B	4
Parrita	2,600	C	3
Puerto Cortés	2,800	C	4
Puerto Jiménez	3,799	D	4
Puntarenas	40,706	B	2
Quepos	4,600	C	3
Roxana	8,656	B	4
Sabalito	13,290	C	5
Sámara	2,631	B	2
San Antonio*	9,100	B	3
San Ignacio	1,400	B	3
San Isidro	14,400	C	4
San José	318,765	B	3
San Juan*	29,360	B	3
San Nicolas*	16,200	B	4
San Pedro*	31,736	B	3
San Ralael	12,751	A	2
San Ramón	13,168	B	3
San Vicente*	30,852	B	3
Santa Cruz	10,800	B	2
Santa Cruz	3,727	B	4
Santiago	5,000	B	3
Santo Domingo*	7,323	B	3
Savegre	3,246	C	3
Siquirres	15,700	B	4
Tilarán	7,100	B	2
Turrialba	23,500	B	4
Upala	11,417	A	2
Veintisiete de Abril	8,629	B	1
Volcán	5,794	C	4
Zarcero*	2,300	B	3

*Does not appear on the map; key shows general location.
Source: 1995 official estimates.

part in colorful festivals on religious holidays. Bullfights, fireworks, and masked parades attract thousands of Costa Ricans and foreign tourists to San José during the annual Christmas festivals.

Costa Rica has been a leader among developing nations in the creation of national parks. Its extensive park system attracts many tourists. The system includes sandy beaches where sea turtles come to lay their eggs, tropical rain forests that are the homes of monkeys and colorful birds, and several active volcanoes.

The land and climate

A chain of high mountain ranges, which are called *cordilleras*, crosses central Costa Rica from northwest to southeast. The cordilleras divide the country into three land regions: (1) the Central Highlands; (2) the Caribbean Lowlands; and (3) the Pacific Coastal Strip.

The Central Highlands consist of two large areas of fertile farmland—the *Meseta Central* (Central Plateau) and the *Valle del General* (Valley of the General). The steep cordilleras surround each area. The Meseta Central is the country's heartland. About 75 percent of the people live there. The Meseta's rich volcanic soil and favorable climate also make it the country's chief coffee-growing region. Daytime temperatures range from 75 to 80°F (24 to 27°C) the year around. The area receives about 70 inches (180 centimeters) of rainfall a year. The Valle del General lies to the southeast. It is an agricultural region of hills and plains. Daytime temperatures range from 80 to 90°F (27 to 32°C). Yearly rainfall averages about 110 inches (279 centimeters).

The Caribbean Lowlands, a wide band of swampy tropical jungles, lie along the east coast. The daytime high temperature averages about 100°F (38°C). Yearly

rainfall ranges from 150 to 200 inches (381 to 510 centimeters).

The Pacific Coastal Strip is largely an area of lowlands along the west coast. Low mountains rise along most of the shore. This region has an ideal climate for growing bananas. Daytime temperatures range from 77 to 100° F (25 to 38° C). The annual rainfall totals about 130 inches (330 centimeters).

Economy

Costa Rica's most valuable natural resource is its fertile volcanic soil. Forests of oaks, pines, and tropical hardwoods cover about a third of the country's land. But *deforestation* (destruction of forests) is a problem. Costa Rica also has small deposits of bauxite and manganese.

About a fifth of Costa Rica's workers are engaged in farming or ranching. Bananas, beef cattle, *cacao* (seeds used to make chocolate), coffee, corn, rice, and sugar cane rank as the chief agricultural products. Farmers also grow cut flowers; and oranges, beans, potatoes, and other fruits and vegetables. Manufacturing employs about 15 percent of the labor force and is growing in importance. The leading manufactured products include cement, clothing, computer chips, cosmetics, fertilizer, furniture, machinery, medicines, processed foods, and textiles.

Costa Rica's economy depends heavily on foreign trade. Its leading exports include bananas, beef, coffee, computer chips, and sugar. Its chief imports include petroleum, chemicals, and manufactured goods. The United States is Costa Rica's major trading partner. Germany ranks second. Costa Rica belongs to the Central American Common Market, an economic union that was formed to stimulate trade among its members.

The Pan American Highway links all of Costa Rica's provincial capitals except Limón (see **Pan American Highway**). Railroads connect the port cities of Limón and Puntarenas to San José. Costa Rica has an average of about 1 automobile for every 27 people. Costa Rican Airlines has flights from San José to other Central American cities and to Mexico and the United States.



WORLD BOOK map

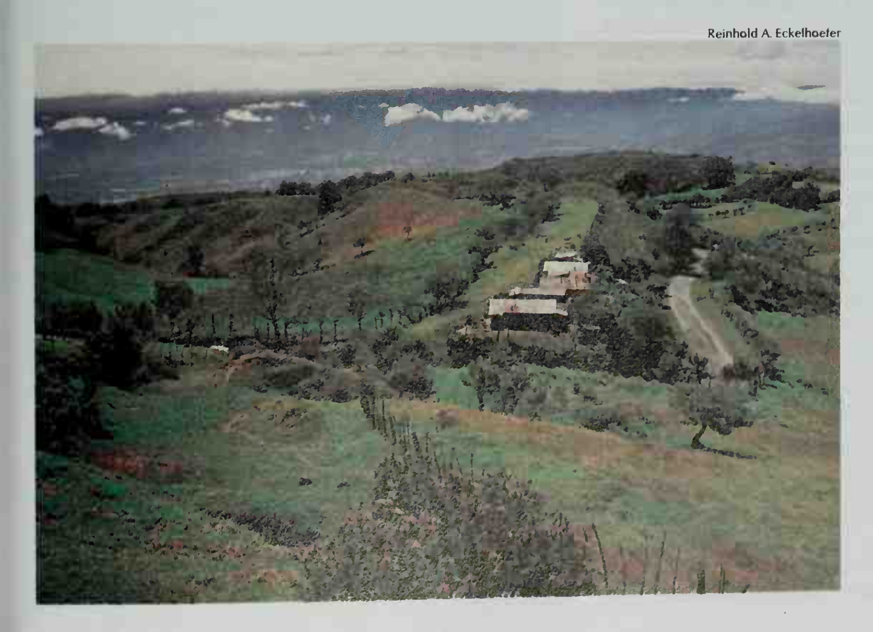
Costa Rica has three land regions. Most people live in the Central Highlands, where the temperatures are more comfortable than in the Caribbean Lowlands and the Pacific Coastal Strip.

Most Costa Rican families own a radio. The country has about one television set for every six people. Costa Rica's four daily newspapers are all published in San José.

History

Indians were the first people to live in what is now Costa Rica. By 1000, the Corobicí tribe had settled in the northern valleys, and the Boruca had migrated to lands in the south. The Carib, Chorotega, and Nahau Indians arrived in the 1400's. Most of the Indians raised crops near their villages and hunted small game.

Reinhold A. Eckelhoefer



The Central Plateau is the agricultural heartland of Costa Rica. Coffee, corn, rice, and sugar cane grow on the rolling hillsides. The city of San José lies in the distance.



Ann Hagen Griffiths, DPI

Coffee beans drying in the sun are raked by workers at a *beneficio* (processing plant) in the Central Plateau. Coffee ranks as Costa Rica's chief export.

Colonial period. Christopher Columbus arrived in Costa Rica in 1502. Rumors of gold deposits in the area soon lured hundreds of Spaniards to the new land. The Spaniards found little mineral wealth. But many of them stayed to become farmers in the Central Highlands. Governor Juan Vásquez de Coronado founded the first permanent settlement at Cartago in 1564. Many Spaniards tried to enslave the Indians, but most of the tribes fought fiercely to stay free.

Independence. Costa Rica remained a Spanish colony until 1821. That year, Costa Rica and Spain's other Central American colonies broke away from Spanish rule. They joined the Mexican Empire the next year. In 1823, the Central American states withdrew from Mexico and formed the United Provinces of Central America. The union began to collapse in 1838, and Costa Rica declared its independence.

In 1842, Francisco Morazán overthrew the dictatorship of President Braulio Carrillo and became president. Morazán attempted to revive the union, but his enemies killed him five months after he took office. Weak leaders governed the country until 1849, when Juan Rafael Mora began a 10-year term as president. Mora established Costa Rica's first national bank, its first street-lighting system, and many public schools.

Revolutions and reforms. Since the late 1800's, Costa Rica has had several revolutions. General Tomás Guardia overthrew the government of Costa Rica in 1870 and ruled as a dictator for 12 years. He encouraged large-scale cultivation and heavy exports of coffee. His government improved the country's public school system and built a railroad from San José to Limón. Much progress toward democracy was made after 1889. But in 1917, Federico Tinoco seized the presidency. After political turmoil forced Tinoco to resign in 1919, Costa Rica resumed its progress toward democracy and social reform.

In 1948, Otilio Ulate won the presidential election, but the National Assembly declared the results illegal. Colonel José Figueres then led a revolt in support of Ulate to prevent what he said was a threatened Communist takeover. Figueres took office as interim president, reorganized the government, and placed banks under national control. He also replaced Costa Rica's army with a 4,000-member Civil Guard. In 1949, Ulate was inaugurated as president.

Figueres, the founder and head of the National Liberation Party (PLN), was elected to the presidency in 1953. He raised the minimum wage, expanded the public school system, and increased the tax on imports. In 1955, a band of exiled Costa Ricans staged an air and land invasion of the country from Nicaragua, but were quickly defeated. Since 1958, the PLN and its opposition parties have alternated winning national elections several times.

From 1963 to 1965, the volcano Irazú erupted and showered tons of ash over San José and the surrounding countryside. The volcanic eruptions damaged the coffee crop and forced thousands of people to abandon their homes.

Recent developments. Figueres won the presidency again in 1970, but then retired in 1974. Since 1974, Costa Rica has continued its orderly succession of democratic governments. Most Costa Rican presidents have worked to maintain traditional neutrality in international affairs while maintaining good relations with the United States. In 1985, several political parties united to form the Social Christian Unity Party.

During the early 1980's, Costa Rica's economy began to decline. The country's economic problems included a high unemployment rate, low earnings from exports, and a large foreign debt. The United States briefly increased its financial aid to Costa Rica in response to the problems.

Oscar Arias Sánchez, who served as Costa Rica's president from 1986 to 1990, played a leading role in creating a regional peace plan for Central America. He won the 1987 Nobel Peace Prize for his efforts. John A. Booth

Related articles in ***World Book*** include:

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Outline

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A. Ancestry
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C. Food
D. Education
E. Recreation
III. The land and climate
A. The Central Highlands
B. The Caribbean Lowlands
C. The Pacific Coastal Strip
IV. Economy
V. History

Questions

How did Costa Rica get its name?
What percentage of the people can read and write?
What is the national sport of Costa Rica?
How fast is Costa Rica's population growing?
Why did the ancestors of Costa Rica's blacks come to Costa Rica from the island of Jamaica in the late 1800's?
What are the *cordilleras*?
In which land region do most Costa Ricans live?
What are Costa Rica's leading exports?
What is Costa Rica's chief natural resource?
What was the United Provinces of Central America?

Costello, *kah STEHL oh* or *KAHS tuh LOH,* **John Aloysius,** *AL oh IHSH uhs* (1891-1976), served as prime minister of Ireland from 1948 to 1951 and from 1954 to 1957. In 1948, Costello, then head of the Fine Gael party, took control of the Irish Free State from Eamon de Valera, who had led the state for 16 years. Costello declared the state an independent republic in 1949. De Valera was prime minister between Costello's terms, and, in 1957, his victory ended Costello's second term. Costello was born on June 20, 1891, in Dublin and received a law degree. He served as attorney general of the Irish Free State from 1926 to 1932. See also **De Valera, Eamon; Ireland** (The Republic of Ireland). Thomas E. Hachey

Costume. See Clothing; Theater (Costume design).

Côte d'Azur, *koht da ZHOOR,* is the eastern end of the Mediterranean coast of France. This area includes part of the French Riviera, a famous vacation resort (see **Riviera**). The name *Côte d'Azur,* meaning *azure coast,* was given to this region because of its beautiful blue sea and sky. Groves of palm and orange trees and gardens of tropical flowers line the shore. The Côte d'Azur is a health resort area and playground for travelers from all parts of the world. Its chief cities include Cannes, Antibes, and Nice in France; and Monte Carlo in Monaco.
Hugh D. Clout

Côte d'Ivoire, *koht dee VWAR,* also known as Ivory Coast, is a country that lies along the Gulf of Guinea on the west coast of Africa. Agriculture is the most important economic activity in the country, and farming provides a livelihood for a majority of the population. Côte d'Ivoire is the world's leading exporter of *cacao beans,* which are used to make chocolate.

The country's official name is République de Côte d'Ivoire, which is French for Republic of the Ivory Coast. The name first appeared on European maps of West Africa in the late 1600's as Côte des Dents ou de l'Yvoire (Tusk or Ivory Coast). This name refers to the coastal trade in elephant tusks at that time. France declared Côte d'Ivoire a colony in 1893 but did not fully control it until 1915. Côte d'Ivoire gained independence in 1960.

Yamoussoukro is the capital of Côte d'Ivoire. Most government offices, however, are in Abidjan, the economic center and former capital of the country. Abidjan is also Côte d'Ivoire's largest city and main port.

Government. According to the Constitution adopted in July 2000, the president is Côte d'Ivoire's highest government official. All presidential candidates must have been born in Côte d'Ivoire to parents who themselves are both Ivorian. No person who has ever used another nationality can run for president. The president is elected by the people to a five-year term and can be reelected only once. The president appoints a prime minister and other ministers to help carry out the functions of government. The National Assembly, whose 225 members are elected to five-year terms, makes the nation's laws. A supreme court heads the nation's court system.

People of Côte d'Ivoire include four large cultural groups. The Akan peoples live in the southeast, the Kru in the southwest, the Voltaic in the north and northeast, and the Mandé in the west central and northwestern regions. These four main groups are made up of over 60 smaller groups, including the Baoulé, Bété, and Senufo.

Since the mid-1900's, a large number of immigrants, mainly from Burkina Faso, Mali, and Guinea, have moved to Côte d'Ivoire. The population also includes many people of French, Lebanese, or Syrian descent.

French is the official language of Côte d'Ivoire. The Jula (Dyula) language, which is used in trade, is the most widely spoken language.

The majority of Ivorians live in small villages. The villages typically consist of several *compounds.* Each compound is made up of groups of homes that house members of an *extended family.* An extended family is one

Côte d'Ivoire

National park (N.P.)
International boundary
Road
Railroad
National capital
Other city or town
Elevation above sea level





WORLD BOOK map

Facts in brief

Capital: Yamoussoukro.
Official language: French.
Area: 124,504 mi² (322,463 km²). *Greatest distances*—north-south, 420 mi (676 km); east-west, 411 mi (661 km). *Coastline*—315 mi (507 km).
Elevation: *Highest*—Mount Nimba, 5,748 ft (1,752 m). *Lowest*—sea level.
Population: *Estimated 2002 population*—15,417,000; density, 124 per mi² (48 per km²); distribution, 54 percent rural, 46 percent urban. *1998 census*—15,366,672.
Chief products: *Agriculture and forestry*—bananas, cacao, cassava, coffee, corn, cotton, palm oil, pineapples, rice, timber, yams. *Manufacturing and processing*—processed foods, refined petroleum products, textiles, timber products.
National anthem: "L'Abidjanaise" ("Hail O Land of Hope").
Flag: Vertical stripes of orange, white, and green. See Flag (picture: Flags of Africa).
Money: *Basic unit*—franc. One hundred centimes equal one franc.



Odyssey Productions

The skyline of Abidjan rises alongside a lagoon. Abidjan is the largest city and main port of Côte d'Ivoire. The port is a center of importing and exporting in West Africa. A canal connects the lagoon with the Gulf of Guinea.

that includes such relatives as parents, married children and their offspring, aunts, uncles, and cousins. Village houses have mud walls and thatched or metal roofs.

Sharp contrasts exist in housing, health, employment, and education between middle- and upper-income and poor households in the cities. For example, wealthy and middle-class people live in modern apartment buildings or in spacious villas. The urban poor inhabit densely settled districts that receive few government services.

About 40 percent of the people are Muslims, and about 27 percent are Christians. Many Ivorians practice traditional African religions.

About half the people of Côte d'Ivoire 15 years of age and older can read and write. For the literacy rate, see **Literacy** (table). The University of Cocody in Abidjan is the nation's largest institution of higher learning.

The land of Côte d'Ivoire rises gradually from the Atlantic Ocean. The eastern part of the coast is flat and sandy. A sand bar, no more than 4 miles (6 kilometers) wide, extends west from the neighboring country of Ghana for 180 miles (289 kilometers) along the coast. Behind the sand bar lie deep lagoons. The western part of the coast has small, rocky cliffs. Beyond the coastal strip is a tropical forest, from 95 to 185 miles (153 to 298 kilometers) wide. Through the years, much of the forest has been cleared to make farmland. In the north, the forest changes to *savanna* (grassland with scattered trees). The Guinea highlands, hills covered by forests, rise above

© P. Robert, Sygma



Our Lady of Peace, located in Yamoussoukro, the capital of Côte d'Ivoire, is the largest Christian church in Africa and one of the largest in the world. The church was completed in 1989 and dedicated in 1990.

5,000 feet (1,500 meters) in west-central Côte d'Ivoire.

The major rivers of Côte d'Ivoire are the Bandama, the Cavally, the Comoé, and the Sassandra. The 500-mile (800-kilometer) Bandama is the longest.

The coastal region is hot and humid. Temperatures there vary from 76 to 83 °F (24 to 28 °C), and annual rainfall ranges from 79 to 128 inches (201 to 325 centimeters). Temperatures in the central forest region vary from 57 to 103 °F (14 to 39 °C), and annual rainfall totals from 39 to 98 inches (99 to 249 centimeters). In the northern savanna, the temperature rises to 120 °F (49 °C). Annual rainfall totals 60 to 80 inches (150 to 200 centimeters).

Economy. Cacao beans, coffee, and palm oil are Côte d'Ivoire's chief exports. Other major exports include bananas, cotton, petroleum products, pineapples, and rubber. Ivorian farmers also grow cassava, corn, rice, and yams; and they raise cattle, sheep, and goats.

A number of the industries and manufacturing plants in Côte d'Ivoire process the country's raw products. These operations include petroleum refining; the processing of palm oil, pineapples, sugar, timber, and tuna; and the production of textiles.

History. Before the arrival of the Europeans, parts of what is now Côte d'Ivoire consisted of powerful kingdoms, including the Kong, Bouna, Gayman, Kabadugu, and Sanwi. Beginning in the early 1700's, the French established trading posts along the coast where traders bartered slaves and ivory for European goods.

A number of treaties in the mid-1800's gave France sovereignty over much of the coastal area. The northern savanna, however, was conquered militarily in the 1890's by French troops commanding African mercenaries. France then joined its interior colonies with its new possession on the Gulf of Guinea.

Many French settlers established coffee and cacao plantations and obtained logging rights in the Côte d'Ivoire colony. Africans were forced to work for little pay on these operations and suffered great hardships. The French also forced Africans to supply labor for public works projects, such as roads and railroads.

France attached a large part of its colony of Upper Volta (now the nation of Burkina Faso) to Côte d'Ivoire from 1932 to 1947. The French took this action to ensure a steady supply of low-cost labor to Côte d'Ivoire.

During World War II (1939-1945), feelings of nationalism began to grow among the people of Côte d'Ivoire. After the war ended, France carried out a number of political and economic reforms in the colony. These reforms, along with high world market prices, led to the expansion of African-owned coffee and cacao farms.

Côte d'Ivoire became an independent republic in 1960. Felix Houphouët-Boigny, who led the independence movement of French territories in western Africa, became the republic's first president.

During the 1960's and 1970's, the government borrowed heavily to invest in construction and social development projects. When world market prices for coffee and cacao plunged in the 1980's and 1990's, the country faced severe debt problems. The government obtained new loans from the International Monetary Fund and the World Bank. As a condition for receiving these loans, Côte d'Ivoire reduced public spending, sold off state-owned companies to private investors, and made other economic reforms.

Houphouët-Boigny served as Côte d'Ivoire's president until his death in 1993. Henri Konan Bédié, the president of the National Assembly, succeeded him and was elected to a full term as president in 1995. In 1999, military officers led by General Robert Gueï ousted Bédié and set up a transitional government. In July 2000, voters approved a new constitution designed to return the country to civilian rule. A presidential election was held in October, and legislative elections were held in December. In October, when it appeared that presidential candidate Laurent Gbagbo would defeat Gueï, Gueï shut down the election commission and declared himself the winner. But mass protests in Abidjan forced Gueï from office, and Gbagbo was sworn in as president. Former Prime Minister Alassane Ouattara was barred from running in the presidential and legislative elections because of questions about his nationality. In late 2000 and early 2001, violent clashes took place between Ouattara's supporters and Gbagbo's supporters. Thomas J. Bassett

See also **Abidjan; French West Africa; Houphouët-Boigny, Felix; Yamoussoukro.**

Cotillion, *koh TIHL yuhn,* is one of a family of ballroom dances for four couples in a square formation. These dances were popular from the late 1600's through the 1800's. About 1827, a new style of cotillion became popular as the final event of a ball. The couples sat around the edge of the room while a "gentleman leader" set up gamelike situations called *figures.* Figures included exchanging party favors or forfeiting places, as in musical chairs. There was always an element of surprise. A formal ball, especially at which debutantes are presented, is often called a cotillion. Patricia W. Rader

Cotopaxi, *KOH toh PAK see,* in the Andes Mountains of Ecuador, is one of the world's highest active volcanoes. It is 40 miles (64 kilometers) south of Quito, Ecuador (see **Ecuador** [map]). Its nearly perfect cone, with slopes of about 30 degrees, rises 19,347 feet (5,897 meters) above sea level, and is covered with glaciers and snow fields. Its crater is about 2,600 feet (792 meters) across. In 1877, a violent eruption caused ashfalls and mudflows that killed about 1,000 people. Gregory Knapp

See also **Mountain** (diagram: Major mountains).

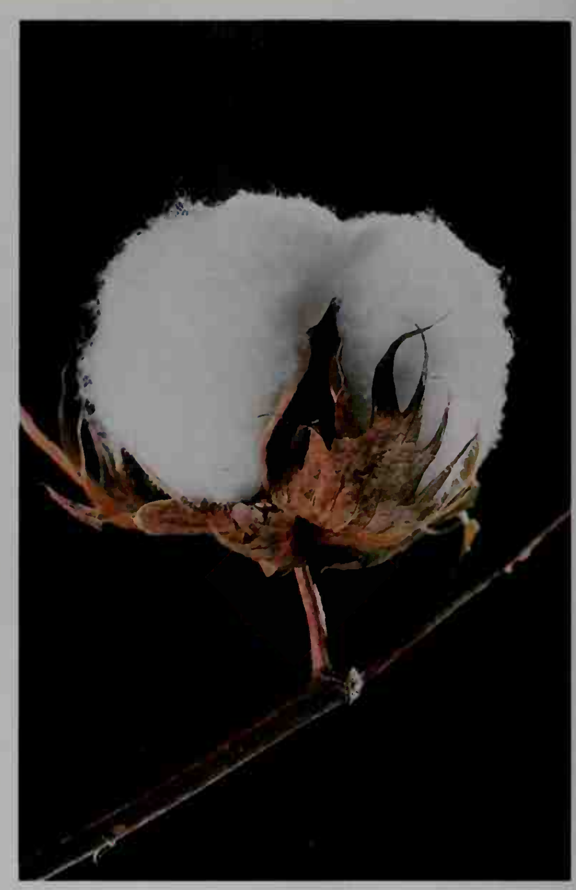
Cottage industry was a home-based system of manufacturing widely used during the 1700's and 1800's. The term *cottage industry* also refers to any present-day industry in which goods or services are made at home.

Cottage industry basically involved rural families adding to their agricultural income by making products in the home. A merchant provided the raw materials, collected and marketed the finished item, and paid the family a percentage of the price he received. The most important products made by cottage industry were cloth and clothing. Other products included shoes, cigars, and hand-decorated items.

In the United States, the cottage industry system developed in cities about 1870. The practice resulted in the harsh *tenement house system* and lasted until about 1920. Tenements were crowded, unsafe apartment buildings in which immigrant families both lived and worked. The immigrants worked for extremely low wages, usually making garments. Today, some hand-decorating, sewing, and other highly specialized activities still operate as cottage industries. Warren Van Tine

See also **Industrial Revolution** (The textile industry).





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A field of cotton produces fluffy white bolls at harvesttime. A woman in India picks cotton by hand, *left*. The photo at the right shows a ripened boll that has split open.

Cotton

Cotton is the most widely used of all plant fibers. Cotton fibers are woven into soft, strong, absorbent fabrics to make clothing, bedsheets, carpeting, tablecloths, and other items. Other parts of the plant provide raw materials for a wide variety of useful products.

People have cultivated the cotton plant and woven its fibers into cloth for thousands of years. Today, cotton is a part of almost every person's life. Most people use cotton products daily, and many people have jobs in the cotton industry.

The leading cotton-growing countries are China and the United States. India, Pakistan, and Uzbekistan also produce large cotton crops. Together, these five countries grow about three-fourths of the world's cotton.

Uses of cotton

All parts of the cotton plant are useful. The most important part is the fiber, also called the *lint,* which grows out of the seeds that are inside the cotton *boll* (seed pod). Textile mills spin the fibers into yarn and weave the yarn into fabric. The *linters* (very short fibers on the seeds) are used in making padding, paper, explosives, and other products. Oil from cotton seeds forms the base of many food products. Farmers plow under the stalks and leaves to fertilize the soil. Even the hulls of cotton seeds are useful, serving as livestock feed and as a soil conditioner to improve the texture of the soil.

Cotton fibers are used mostly to make clothing. There are various types of cotton fibers that can be woven into fabrics for different kinds of garments, from rugged work clothing to delicate dresses. Unlike other fibers, the cotton fiber can absorb moisture in its center. This makes cotton clothing feel cooler in summer and warmer in winter than other clothing does because it moves moisture away from the wearer's skin. Clothing made of cotton also is durable because the fibers are strong.

Cotton seeds are used in a wide variety of goods. Manufacturers use the linters from the seeds as raw materials for rayon, paper, photographic film, and other products. Linters also are used to stuff mattresses, cushions, and pads. Bleached, sterilized linters are made into medical cotton pads.

Refined cottonseed oil is a popular cooking oil. It also is a main ingredient of such foods as salad dressing and

C. Wayne Smith, the contributor of this article, is Professor of Cotton Breeding at Texas A&M University.



© David Austen, Tony Stone Images

A mechanical cotton picker pulls cotton from the bolls and blows it into a large steel basket at the back of the machine.

Cotton terms

Bale is a bundle of raw cotton. In the United States, a bale weighs about 500 pounds (227 kilograms).
Boll is the rounded mature seed pod of the cotton plant.
Boll weevil is a beetle whose young feed on cotton *squares* (buds), making them fall off.
Bur is the opened seed case of the cotton plant.
Carding is a process of cleaning and straightening cotton fibers.
Drawing is a process that further straightens the cotton fibers after carding and forms them into a loose rope called a *drawn sliver* (pronounced *SLY vuhr*).
Ginning is the process of separating the cotton fibers from the seeds.
Gray-state cloth, also called *gray goods* or *greige* (pronounced *gray*), is cotton fabric in its natural, grayish-white color before bleaching or dyeing.
Lint is raw ginned cotton that is ready for baling.
Linters are the short fibers that remain on the cotton seed after ginning.
Mercerization is the application of an alkaline solution to cotton cloth or thread to strengthen the cotton, make it hold dye better, and give it luster.
Picker is a machine that separates and cleans the fibers of cotton.
Pima cotton is a type of cotton with strong, silky fibers used to make fine, smooth fabrics.
Roving is a thin strand of cotton fibers ready for spinning.
Sizing is a mixture of starch, gum, and resins that strengthens cotton yarn to better withstand weaving or other finishing.
Sliver (*SLY vuhr*) is a loose rope of cotton fibers. A *card sliver* is thicker and has more tangled fibers than a drawn sliver.
Squares are the buds of cotton blossoms.
Staple is the average length of cotton fibers.
Trash is a term for leaves, stems, and other unwanted plant material in harvested cotton.
Upland cotton is the most common type of cotton.

margarine. Unrefined cottonseed oil is used to make soap, cosmetics, and drugs.

The cottonseed meal that remains after oil extraction serves as livestock feed and plant fertilizer. The cotton seed's protective covering, called the *hull* or *seed coat,* is used for animal feed and as a soil conditioner. Manufacturers also use the hulls to make plastics and synthetic rubber.

The cotton plant

In most parts of the world, the cotton plant is grown as an *annual*—that is, as a plant that grows and dies within one growing season. This section describes the upland cotton plant, from which about 90 percent of the world's cotton crop is produced.

Appearance. The mature upland cotton plant ranges from 2 to 5 feet (0.6 to 1.5 meters) in height and has spreading branches. Depending on growing conditions, each branch may produce from one to several bolls. The plant's leaves are 3 to 6 inches (7.5 to 15 centimeters) wide, some with three or five lobes in them and others with no lobes. The plant's *taproot* (long main root) may grow as deep as 4 feet (1.2 meters) into the ground.

How the plant develops. Farmers in most countries plant cotton seeds in the spring. Cotton seedlings emerge from the soil about a week after planting. Approximately three weeks later, *squares* (flower buds) begin to emerge on the plants. New squares continue to appear for about eight weeks. Each square grows for about three weeks and then opens into a creamy-white flower. The flower has five petals, which are surrounded by leaflike structures called *bracts* and specialized leaves known as *sepals.* The open flower measures about 2 inches (5 centimeters) across.

Within three days after opening, the petals turn pink and then reddish-purple as they dry and fall off. The flower must be pollinated during the first day it is open. Each flower usually pollinates itself.

After the petals fall, the seed pod develops into a boll. Inside the seed pod are about 20 to 40 seeds with fibers and linters growing from them. The seed pod matures into a green, walnut-sized boll in about six to nine weeks. Then the boll begins to dry and split open. The open dried boll, called a *bur,* curves back and exposes the fibers and seeds for harvest.

Kinds of cotton

Scientists have identified 39 *species* (kinds) of cotton plants. Only 4 of the 39 are cultivated. They are (1) *upland;* (2) *Pima,* also called *Egyptian* and *American-Egyptian;* (3) *tree;* and (4) *Levant.* The different species re-

semble each other in most ways. But they differ in such characteristics as height, type of fibers, and blooming time and color of flowers. Each species has varieties with different qualities. For example, some varieties grow best on irrigated land, and some have stronger fibers than others.

The four main species fall into two groups: (1) *New World cotton* and (2) *Old World cotton*.

New World cotton includes upland and Pima cotton. These types of cotton were first cultivated thousands of years ago by Indians in Central and South America and probably are native to these regions.

Upland cotton is cultivated in many parts of the world. The species may have gotten its name in the American Colonies. There, it was cultivated inland or, as the colonists said, "up land" from the Atlantic Coast.

Upland fibers measure from about $\frac{3}{4}$ to $1\frac{1}{4}$ inches (1.9 to 3.2 centimeters) long. They can be made into many kinds of fabrics, including heavy canvas and fine, expensive cloth.

Pima cotton is one name for a species that developed along the coasts of what are now Peru and Ecuador. American colonists cultivated the species as *Sea Island cotton* along the southeast Atlantic Coast of what is now the United States. Scholars believe that growers in the early 1800's crossed Sea Island cotton with a variety of the same species in Egypt. Varieties developed from this cross were brought to the United States in the early 1900's and became known as *American-Egyptian cotton*. Cotton marketed in the United States today as Pima is descended from the original Pima (or Sea Island) cotton and American-Egyptian cotton.

About 8 percent of the world's cotton is Pima, Egyptian, and American-Egyptian. The fibers, which in most cases range from $1\frac{1}{4}$ to $1\frac{1}{2}$ inches (3.4 to 3.8 centimeters) in length, are much stronger than upland cotton fibers. Cotton from this species is used primarily to make high-quality blouses and shirts. It also is used to make sewing thread.

Leading cotton-growing countries



Figures are for a three-year average, 1999-2001.
Source: Food and Agriculture Organization of the United Nations.

Old World cotton includes *tree cotton* and *Levant cotton*. These species are native to northern Africa and parts of Asia and are also called *Asiatic species*. Levant cotton was an important source of lint for centuries in the Old World until other species were introduced and became more profitable. Old World species are relatively unprofitable because they have short, coarse fibers and low crop yields. Today, most of the Old World

How cotton develops An upland cotton plant produces one to several flowers on each branch. After the petals fall, the seed pod develops into a boll. The boll then matures and opens.

WORLD BOOK illustrations by Lorraine Epstein

An open flower has creamy-white petals and measures about 2 inches (5 centimeters) across. The flower remains on the plant for about three days before the petals fall.

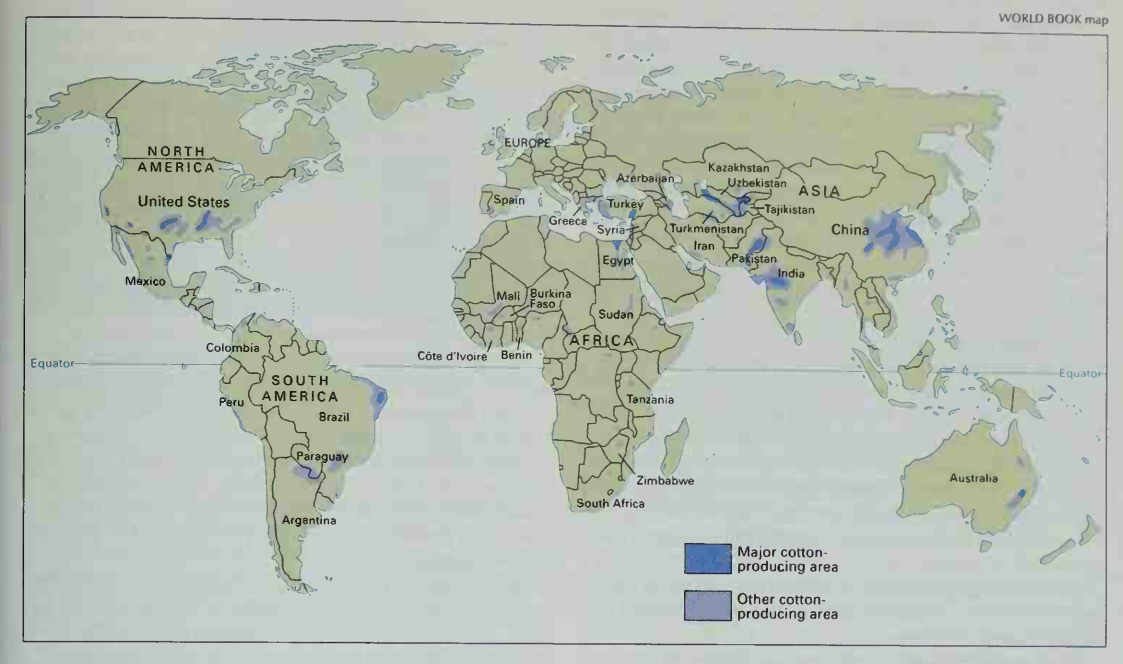
A cross-section of an unopened boll shows the silky white fibers and brownish seeds inside. An unopened boll is approximately the size of a walnut.

Cotton fibers are exposed when the boll dries and splits open. The fibers, which have seeds within them, are called *seedcotton*. Farmers harvest cotton at this stage.

Cotton-producing areas of the world

Cotton grows in many regions of the world. The leading cotton-producing countries are China and the United States. India, Pakistan, and Uzbekistan also produce large cotton crops. In the United States, Texas is the leading cotton producer.

WORLD BOOK map



cotton that is cultivated is used in the communities where it is grown.

Where cotton is grown

The cotton plant originated in the tropics, which have warm to hot temperatures the year around, and it is considered a tropical plant species. Today, however, more than 50 percent of the world's cotton grows in temperate regions—that is, regions north of 30° latitude that have hot summers and cold winters. Farmers plant cotton mostly in areas that have 200 or more days a year in which temperatures do not drop below freezing.

Leading cotton-producing countries. The world's two largest producers of cotton are China and the United States. China produces about one-fourth of the world's cotton, and cotton textiles are a leading Chinese export. Cotton in China grows mainly in the east-central part of the country, near Beijing and Shanghai.

The United States grows about one-fifth of the world's cotton, mostly in the South and Southwest. Texas, California, Mississippi, and Georgia are the leading cotton-producing states.

Other countries. In addition to China, other leading cotton-producing countries of Asia include India, Iran, Pakistan, Syria, Tajikistan, Turkey, Turkmenistan, and Uzbekistan. Important South American producers include Argentina, Brazil, and Paraguay. Benin, Burkina Faso, Côte d'Ivoire, Egypt, and Mali are the main cotton-producing countries in Africa. In Europe, cotton grows mainly in Greece and Spain. Australia also produces a large cotton crop.

Leading cotton-growing states

Tons of cotton grown in a year

State	Tons of cotton grown in a year
Texas	1,018,000 tons (924,000 metric tons)
California	520,000 tons (472,000 metric tons)
Mississippi	392,000 tons (356,000 metric tons)
Georgia	380,000 tons (345,000 metric tons)
Arkansas	327,000 tons (297,000 metric tons)
North Carolina	263,000 tons (238,000 metric tons)
Louisiana	196,000 tons (178,000 metric tons)
Arizona	171,000 tons (155,000 metric tons)
Tennessee	149,000 tons (135,000 metric tons)
Alabama	138,000 tons (125,000 metric tons)

Figures are for a three-year average, 1998-2000.
Source: U.S. Department of Agriculture.

How cotton is grown

Cotton requires a warm to hot climate and a growing season that has many sunny days. The plant grows best in fertile, well-drained soil that gets adequate moisture during the growing season. Sunny weather after the bolls open helps dry the fibers for harvest.

Soil must be rich in nitrogen, potassium, phosphorus, and certain other nutrients to produce a good cotton crop. In industrialized nations, most farmers apply these

elements to the soil in the form of chemical fertilizer. In developing nations, the nutrients may come from the addition of animal manure.

Preparing the soil. Farmers in the United States plant cotton seeds between February and June, depending on the region. Growers *till* (plow) the soil sometime between the last harvest and the new planting season. Tilling loosens the soil so that each seed comes in contact with soil on all sides and thus can absorb moisture for sprouting. Tilling also plows under remains from the previous season's crop. This material decays in the soil and fertilizes the new crop. In the United States and many other countries, farmers till the land mainly by machine. In less industrialized countries, people or animals pull the plows. In areas with severe erosion or little topsoil, farmers do little or no tilling.

Planting is done by machines in most industrialized nations, and by hand in developing nations. After tilling, most farmers prepare *beds* (low ridges) in which they plant the cotton seeds. Planting in beds rather than on a flat field warms the seeds and drains excess moisture away from the seedlings. *Furrows* (narrow grooves) between the beds carry irrigation water. In hot, dry areas, farmers may plant the seeds on a flat field or between extremely low beds to capture rainfall for sprouting and growth.

Care during growth is important in producing a successful cotton crop. Cotton farmers must control diseases, insects, and weeds.

Diseases of cotton fall into four categories: (1) seedling diseases, (2) wilt, (3) blight, and (4) rot. Seedling diseases are caused by fungi. Cold, wet soils that slow or stop seedling growth help bring on these diseases. To kill fungi, farmers treat cotton seeds with chemicals before planting or add chemicals to the soil along with the seeds at planting.

Wilts, blights, and rots are symptoms of plant diseases caused by specific bacteria and fungi. The infections stunt growth or cause plants to wilt or rot. Farmers can best prevent these diseases by planting cotton varieties that are resistant to the disease-causing organisms and by using proper growing techniques. One such technique is to alternate the planting of cotton with crops that do not support disease-causing organisms.



Edward S. Ross

A bollworm is a caterpillar that eats the buds and bolls of cotton plants. Bollworms are among the most destructive insect pests in the United States.

Insects destroy an estimated 15 percent of the world cotton crop each year. Various types of bollworms and boll weevils do most of the damage. Whiteflies leave a sticky film on the fibers that makes them difficult to process and causes an unsightly mold to grow on them. Cotton growers control insects mainly with chemical insecticides. They also use special growing methods and cultivate cotton varieties that have some resistance to insects. In some areas, farmers destroy cotton stalks after harvest so insects cannot live on the stalks. Some farmers try to keep areas near cotton fields free of vegetation that could provide food for harmful insects.

Weeds reduce cotton crop yields by robbing the plants of moisture and nourishment. There are several ways to control weeds. In many developing countries, farmers remove weeds by hand. Nearly all farmers grow cotton in rows to make weed removal easier. Growers in some countries plow weeds under the soil to serve as fertilizer. Most cotton farmers in the United States use weedkillers called *herbicides* to control weeds. These chemicals prevent weeds from sprouting or kill them after they appear.

Harvesting of cotton usually occurs about 150 to 200 days after planting. Many developing nations harvest by hand. Producers in most industrialized nations use machine harvesters. Some countries use both methods. The following section describes machine harvesting.

Before harvest, many farmers apply a chemical called a *defoliant* to the crop. Defoliants cause the leaves to fall off, thus reducing the amount of *trash* (unwanted plant material) in the harvested cotton. Trash lowers the value of cotton by causing flaws in yarn and cloth.

Growers use either a *spindle picker* or a *stripper machine* to harvest cotton. The spindle picker has a series of barbed *spindles* (rods) that revolve as the machine moves along a row of cotton. The *seedcotton* (lint and seeds) catches in the spindles and is pulled from the bur. The machine then removes the seedcotton from the spindles and blows it into the picker.

Like spindle pickers, stripper machines pick seedcotton. But strippers also pull the burs and, in many cases, some leaves and stems off the plants. As a result, seedcotton harvested by a stripper machine contains much more trash than that harvested by a spindle picker.

After harvest, many farmers use a large machine to press the seedcotton into *modules* (compressed stacks) that weigh about 20,000 pounds (9,000 kilograms). Farmers store the modules on or near the cotton field until they are transported to a cotton gin. Other farmers load the seedcotton from the picker or stripper into large trailers and take the cotton immediately to the gin.

Processing and marketing

The processing and marketing of cotton varies somewhat from country to country. This section describes these activities in the United States.

Ginning and baling. The term *cotton gin* applies to the entire mechanical system that performs a process called *ginning*. Ginning separates the fibers from the seeds, dries and cleans the fibers, and then bales the



Cameramann International, Ltd.

Bales of cotton are stacked and moved by a fork-lift truck. Cotton is compressed, wrapped, and tied into rectangular-shaped bales after the ginning process is completed.

cotton. The machines that separate the fibers from the seeds are also called *gins.*

Upland cotton is ginned on a *saw gin* that grabs the fibers and breaks them away from the seeds. Pima cotton fibers are not as firmly attached to the seeds as upland fibers and so can be removed with a *roller gin.* This type of gin passes the seedcotton between two rollers that squeeze the seeds out from the fibers.

After separation, special machines clean and dry the fibers. The fibers are then compressed, wrapped, and tied into rectangular bales at the gin or at factories called *compress warehouses.* In the United States, most bales weigh about 500 pounds (227 kilograms) each. Many of the seeds removed during ginning are transported to oil mills or sold to ranchers and dairy farmers as cattle feed. Some seed may be returned to the farmer for planting the next season's crop.

Classing. Before American farmers sell cotton on the market, a government agency called the U.S. Classing Office evaluates fiber samples from each bale. Until 1991, inspectors called *classers* graded the bales according to: (1) the whiteness of the lint, (2) the amount of trash in the bale, and (3) how well the cotton was ginned. Classers also estimated how long the longest fibers were and called this estimated length the cotton's *staple.*

Today, the Classing Office also uses devices called High Volume Instruments (HVI's) to test and classify samples. HVI's measure fiber length (or staple), strength, and diameter. They also determine the amount of trash in the sample and measure the whiteness.

Selling. After classing, many U.S. farmers sell their cotton to a *broker,* also called a *cotton buyer.* Brokers, in turn, sell the cotton to shippers or textile mills. Some farmers sell directly to shippers or mills. Other producers pool their cotton to sell it in large blocks at competitive prices to shippers or mills.

Sales to textile mills usually take the form of *forward contracting.* In such a transaction, a mill agrees with a broker or farmer to buy a specific amount of a certain quality of fiber at a given price at a specified future time. This transaction, called a *forward contract,* may occur before planting or during the growing season.

In the United States, cotton of average quality can also be bought and sold in the *futures market* on the New York Cotton Exchange, which is part of the Board of Trade of the City of New York. In the futures market, traders buy or sell contracts to receive or deliver a certain quantity of cotton at a specified future time. The price they pay is based on their own estimate of what the future price will be. Buyers seldom actually receive the product for which they buy a contract. Instead, they sell the contract before delivery of the goods. If the price of cotton goes up after they buy the contract, they make a profit when they sell the contract. If the price goes down, they sell the contract at a loss. Cotton of higher-than-average or lower-than-average quality is traded in the United States in a spot market, where it is bought and sold for immediate delivery.

Making cotton into cloth

After cotton is harvested, ginned, and sold to textile manufacturers, spinning mills make it into yarn. The yarn is then made into cloth.

Cleaning and blending. At the mill, workers remove the wrapping and ties from the bales. They then peel layers of cotton from the bales and place them on conveyor belts. The belts move past spikes that fluff the cotton. The cotton then goes to machines that blend the fibers from different bales into a more even mixture. Once the cotton is blended, machines further clean and fluff the fibers and remove leaves, stems, and hulls.

In most mills, the fibers then move through a series of air ducts to a *carding machine,* which straightens the fibers into a thin, filmy sheet. A machine then forms the sheet into a loose rope called a *card sliver* (pronounced *SLY vuhr),* which is coiled into large cans. In some mills, the carding operation includes additional combing to further clean the fibers.

Spinning accomplishes three tasks: (1) it reduces the card sliver from a thick rope to slender yarn, (2) it straightens the fibers, and (3) it twists the fibers into yarn. First, the card sliver is pulled into a series of rollers. In a process called *drawing,* the rollers make the sliver thinner and the fibers more parallel. Drawing turns the card sliver into a more slender rope called a *drawn sliver.* Machines then pull the drawn sliver into a still thinner strand called a *roving.* The roving goes through additional drawing and is then twisted into yarn.

Lengths of yarn are tied end to end and wound on bobbins. In a process called *warping,* the yarn is wound onto a large spool called a *beam.* A *slashing machine* unwinds the yarn from the beam and dips it into a vat of *sizing.* Sizing is a mixture of starch, gum, and resins that strengthens the fibers so they can better withstand weaving. After drying, the yarn is made into cloth by weaving, knitting, or other processes. Newly woven cotton fabric is grayish-white and is called *gray-state cloth, gray goods,* or *greige* (pronounced *gray).*

Finishing is the final step in the production of woven goods. This process removes contaminants from the cloth and produces white fabrics that easily absorb dyes. Finishing consists of desizing, scouring, bleaching, and a process called *mercerization.*

Desizing soaks the fabric to remove the sizing. Machines then *scour* (wash) the fabric with a special solution to remove naturally occurring waxes from the fibers. *Bleaching* makes the fabric uniformly white so it

How cotton cloth is made

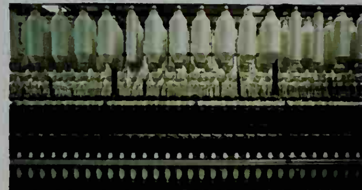
At a textile mill, *carding machines* form cotton fibers into ropes called *slivers.* The slivers are drawn into a strand known as a *roving,* which is spun into yarn. In *warping,* the yarn is wound onto a huge spool. A *slashing machine* feeds the yarn through a mixture that strengthens it for weaving.


S. L. Craig, Jr., Bruce Coleman Inc.

Carding the fibers


S. L. Craig, Jr., Bruce Coleman Inc.

Forming the roving


S. L. Craig, Jr., Bruce Coleman Inc.

Spinning the yarn


Bill Barley, Shostal

Warping


Bill Barley, Shostal

Slashing


Bill Barley, Shostal

Weaving

can be sold as white fabric or evenly dyed. *Mercerization* is the application of a sodium hydroxide solution or other strong alkaline solution to the cloth. This process improves the luster of the fabric and makes it absorb dye more evenly.

After finishing, cotton that has not already been dyed before spinning or as yarn is dyed as fabric. Some cotton fabrics are preshrunk so that they do not become too small after they have been sold as garments.

History

Early days. Cotton plant species developed in both the Eastern and Western hemispheres. The oldest remains of cotton in the New World are fossilized plants dating from about 2900 B.C. found in present-day Mexico. In what is now Peru, Indians twined cotton to make fishing nets and other items as early as 2500 B.C. The earliest woven cotton dates from about 1900 B.C. in that same area. Indians in present-day Mexico and Peru used cotton extensively by about A.D. 1000.

The oldest evidence of cultivated Old World species, from about 3000 B.C., is cotton thread and fabric from the Indus River Valley region in what is now Pakistan and western India. The region first exported cotton textiles to Mesopotamia, an area that included most of modern-day Iraq and parts of Syria and Turkey, about 1500 B.C. Residents of Mesopotamia and nearby areas began cultivating their own cotton plants about 700 B.C. Europeans first grew and wove cotton in present-day Spain and Italy in the A.D. 700's. During the next several hundred years, cotton cultivation and weaving spread throughout much of Europe.

England. By the 1500's, imported cotton textiles had become common in England. The English began to weave cotton in the 1600's. They imported raw cotton from countries bordering the Mediterranean Sea, and later from America's Southern Colonies. In a system of production called the *cottage industry,* people spun and wove cotton at home and sold the cloth to merchants.

In the cottage industry system, the supply of woven cotton textiles could not keep up with the demand from merchants. This spurred the development of machines that could process cotton in large quantities. These machines, invented in England in the 1700's, were crucial in bringing about the Industrial Revolution, a period of rapid industrialization. They also made England one of the largest producers of woven cotton goods.

The first significant improvement in machinery for cotton processing was the *fly shuttle* (also called *flying shuttle),* developed in 1733 by John Kay, an English inventor. The shuttle increased weaving speed by weaving the yarn mechanically rather than by hand. As a result, weavers needed more cotton yarn than before.

The *spinning jenny,* invented about 1764 by a weaver named James Hargreaves, enabled spinners to provide more yarn more quickly to weavers. It was the first machine to spin more than one yarn at a time. The *water frame,* invented by Richard Arkwright in 1769, spun yarn even more quickly by running on water power. Ten years later, a weaver named Samuel Crompton invented the *spinning mule.* This machine combined features of the spinning jenny and the water frame and gradually replaced both.

American colonists began growing cotton in the early 1600's. They wove cotton into coarse cloth for their own use. In the United States, large-scale cotton growing began in the South in the late 1700's. The colonists exported raw cotton to England, where it was made into textiles.

English manufacturers tried to keep the new spinning and weaving machines out of the United States. They wanted the United States to continue to sell its raw cotton to England and to buy back finished cloth. But Americans wanted to manufacture their own textiles. Finally, in the 1790's, the first American cotton mills were built in New England. Other mills soon sprang up.

In 1793, Eli Whitney developed a cotton gin that provided a fast, economical way to separate the cotton-

seeds from the fibers. This gin could do the work of 50 people and made it possible to send more cotton to the mills. Cotton textile manufacturing in New England grew rapidly.

With the invention of Whitney's cotton gin, the cotton industry in the Southern United States also expanded. The slave population grew in the early 1800's because planters needed more people to pick and gin cotton. Many Southern farmers felt they could not make money growing cotton without the slave labor. Many Northerners opposed slavery, and this conflict became one cause of the American Civil War (1861-1865).

In the 1830's, some cotton mills began to process cotton seeds in an attempt to extract cottonseed oil. But oil extraction was unsuccessful until just after the Civil War, when more efficient machines came into general use. Selling cottonseed oil then became profitable, and the number of mills processing cotton seeds grew. Also after the war, Southerners built large numbers of mills to make cotton cloth. These mills prospered in part because land was cheaper and taxes lower than in the North. In addition, Southern laborers worked for lower wages than Northern workers did.

The boll weevil began to seriously damage U.S. cotton crops in the 1890's. This beetle, native to Mexico and Central America, had spread into Texas early in that decade. By the early 1900's, it had multiplied across much of the South. Boll weevils cause the young squares to drop off the plant, thus decreasing the number of bolls that produce cotton fibers.

American cotton growers successfully fought off the boll weevil by modifying their growing methods. They picked and burned infested squares and bolls. They also planted cotton rows farther away from each other than usual so that heat from additional sunlight would kill developing weevils. The cotton industry recovered in the 1920's but then faltered again in the 1930's during the Great Depression, a severe worldwide economic slump.

Synthetic fibers. By 1960, the cotton industry was again thriving, and cotton accounted for about three-fourths of all fibers used in the United States. But this fraction began to shrink as synthetic fibers became increasingly popular. By 1977, only about one-third of all fibers used were cotton.

Decreased demand for cotton, as well as rising production costs, caused economic problems for United States cotton farmers. In response, the U.S. government enacted measures in the 1960's and 1970's to make it easier for farmers to obtain loans to support their farms. It also gave money to farmers who met certain requirements. In 1971, cotton farmers formed an organization now called Cotton Incorporated. It supports cotton research, works to develop new cotton products, and promotes the sale of cotton products.

Government assistance helped keep many farmers in business during this period. Then, at the end of the 1970's, demand for cotton clothing began to increase. Demand grew partly because people wanted softer, more comfortable clothing than synthetics could provide. The increase also resulted from a drop in the price of cotton goods, and the availability of a wider variety of high-quality blends of cotton and synthetics. By 1990, cotton had rebounded to make up about half of the total fibers used.

Technical advances. Farmers, researchers, and manufacturers are working to solve the problems that still face the cotton industry. Scientists have identified what makes some types of cotton plants resistant to certain pests. They are attempting to develop varieties that are naturally resistant to insects and diseases. Manufacturers also are developing ways of improving trash removal and methods of detecting and removing fibers damaged during manufacturing.

Scientific classification. Cotton makes up the genus *Gossypium* in the mallow family, Malvaceae. There are about 40 species, but only 4 of them are cultivated. Upland cotton is *G. hirsutum*. Pima cotton, Sea Island cotton, and American-Egyptian cotton are common names for *G. barbadense*. Tree cotton is *G. arboreum*. Levant cotton is *G. herbaceum*. Each of these four species includes several varieties. C. Wayne Smith

Related articles in *World Book* include:

Cotton cloths

Broadcloth	Chenille	Gabardine	Percale
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Other related articles

African Americans (The growth of slavery; pictures)
Boll weevil
Brown lung
Cotton gin
Cottonseed oil
Guncotton
Pink bollworm
Rayon
Spinning
Textile
Thread
Weaving
Whitney, Eli

Outline

I. **Uses of cotton**
  A. Cotton fibers
  B. Cotton seeds
II. **The cotton plant**
  A. Appearance
  B. How the plant develops
III. **Kinds of cotton**
  A. New World cotton
  B. Old World cotton
IV. **Where cotton is grown**
  A. Leading cotton-producing countries
  B. Other countries
V. **How cotton is grown**
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VI. **Processing and marketing**
  A. Ginning and baling
  B. Classing
  C. Selling
VII. **Making cotton into cloth**
  A. Cleaning and blending
  B. Spinning
  C. Finishing
VIII. **History**

Questions

Which parts of the cotton plant are made into manufactured products?
Which species of cotton produces about 90 percent of the world's annual cotton harvest?
What are the four main kinds of cotton diseases?
How do cotton farmers control weeds?
Who invented the cotton gin that stimulated the U.S. cotton industry in the early 1800's?
What tasks does spinning accomplish?
Why did the demand for cotton fabrics increase in the 1980's?
What is *mercerization*? What does it do?
When did American Indians first weave cotton textiles, according to archaeological evidence?
Why did English manufacturers want to keep new cotton spinning and weaving machines out of the United States in the late 1700's?

Cotton, John (1584-1652), was a Puritan minister and author. He was born in Derby, England. While serving as vicar of St. Botolph's Church in Lincolnshire from 1612 to 1633, Cotton became widely known as a pastor and preacher. In 1633, he fled to America to escape persecution as a Puritan. While serving with a church in Boston, Cotton became one of the most respected leaders of New England. Many New England children memorized his catechism, *Milk for Babes* (1646).

Cotton believed that church and state should be close partners, and he often advised both about proper government. He opposed unrestrained democracy, in which people ruled themselves. Cotton believed the people should choose their rulers, who should govern according to certain unchanging principles. Cotton became New England's spokesman against the extreme Calvinist political and religious views of Roger Williams, founder of the Rhode Island colony. Mark A. Noll

See also **Williams, Roger** (In Rhode Island).

Cotton gin is a machine for removing the seeds from cotton fibers. It is widely believed that the American inventor Eli Whitney produced the first cotton gin. However, simple cotton gins were first used in India during ancient times. A version of these gins, the *roller gin,* had reached the American Colonies by the 1740's. In 1793, Whitney invented a faster, more economical way of separating cottonseeds from the fibers. His cotton gin helped make the United States the world's leading cotton grower.

Roller gins consisted of a pair of grooved wooden rollers that pressed the seeds from the cotton. These gins could remove the seeds from a variety of cotton called *long-staple.* But they could not remove the tightly clinging seeds from *short-staple* cotton. Short-staple cotton was raised only on small plots because it took one person a full day to separate the seeds from a pound (0.45 kilogram) of fiber.

Whitney's cotton gin was able to remove the seeds from short-staple cotton. As the crank on the gin turned, a cylinder covered with rows of wire teeth revolved. The teeth drew the cotton through slots so tightly spaced that the seeds could not enter. A roller with brushes removed the cotton fibers from the teeth and deposited them in a hopper. Whitney's larger gins could process 50 times as much cotton in a day as could 50 people working by hand. Short-staple cotton quickly became a cash crop.

Today, the term *cotton gin* refers to the entire mechanical system that dries, cleans, removes the seeds, and bales the cotton. The machine that removes the seeds from cotton fiber is called a *gin stand.*

R. Douglas Hurt

See also **Agriculture** (picture: The cotton gin); **Cotton** (Ginning and baling); **Whitney, Eli.**

Additional resources

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Britton, Karen G. *Bale O'Cotton: The Mechanical Art of Cotton Ginning.* Texas A & M Univ. Pr., 1992.
Mirsky, Jeannette, and Nevins, Allan. *The World of Eli Whitney.* Macmillan, 1952.

Cottonmouth. See **Water moccasin.**

Cottonseed oil is an edible oil made from the seeds of cotton plants. It is used primarily to make shortening and margarine and as a cooking and salad oil. The southern and southeastern regions of the United States produce much of the world's cottonseed oil.

Cottonseeds consist of 15 to 24 percent oil. Manufacturers remove the *hull* (outer covering) of the seed and then extract the oil. Most producers obtain the oil by *solvent extraction.* This method involves soaking the seeds in a solvent, which draws the oil from the seed. Crude cottonseed oil has a reddish-brown color and unpleasant flavor. Further refining and deodorizing removes the impurities from the oil and produces a colorless, mild-tasting product. Daniel R. Sullivan

See also **Cotton** (Cotton seeds).

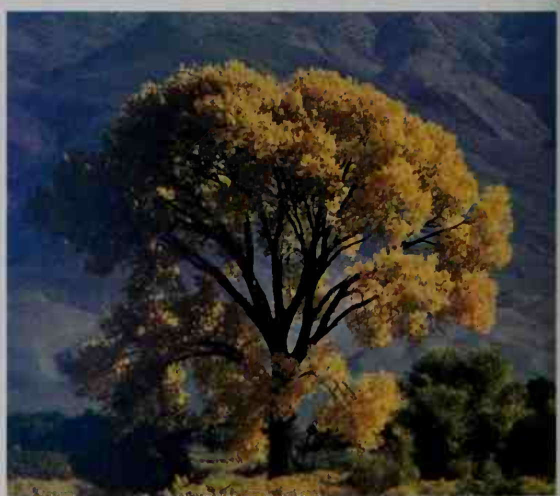
Cottontail. See **Rabbit.**

Cottonwood is a group of large, spreading poplar trees that grow in the United States. These trees grow quickly and make good shade trees, but they are short



National Museum of History and Technology

The cotton gin above is a model of the one Eli Whitney developed in 1793 to separate cotton fiber from the seed.



Alice K. Taylor, Photo Researchers

A cottonwood has a spreading, leafy crown, which makes it a good shade tree. Cottonwoods thrive in moist soils in many parts of the United States. They grow rapidly.

lived. Early in spring, their small, greenish flowers droop in long clusters called *catkins,* and form masses of cottony seeds. The shiny green leaves are shaped like a triangle, and have wavy, toothed edges. The thick, dull gray bark of the cottonwood tree splits into ridges and long furrows. Cottonwood trees grow in moist soils, especially along rivers.

The *eastern cottonwood* grows throughout the eastern regions of the United States. *Black cottonwood,* the tallest western broadleaf tree, grows along the Pacific Coast. The whitish or light brown wood of these trees is soft and weak. Manufacturers use it for boxes and crates, woodenware, luggage interiors, furniture, pulpwood, and *excelsior* (wood shavings used as packing material). Several other types of cottonwoods are used as windbreaks or ornamental trees, but they are not commercially important. Cottonwood is the state tree of Kansas, Nebraska, and Wyoming.

Scientific classification. Cottonwoods belong to the willow family, Salicaceae. The eastern cottonwood is *Populus deltoides.* The black cottonwood is *P. trichocarpa.* Richard C. Schlesinger

See also **Catkin; Poplar; Tree** (Familiar broadleaf and needleleaf trees [picture]).

Cotyledon, *KAHT uh LEE duhn,* is the leafy portion of a plant's *embryo.* The embryo is the part of the seed from which a mature plant develops. It consists of a *radicle* (short root) and a *plumule* (short bud), connected by a *hypocotyl* (short shoot) that bears one or more cotyledons. Because they form within seeds, cotyledons also are known as *seed leaves.* If a peanut is split apart, the two halves are the cotyledons. The remaining parts of the peanut embryo can be seen where the cotyledons are attached to the embryonic stem.

Flowering plants, called *angiosperms,* have embryos with one or two cotyledons. Those with one cotyledon are known as *monocotyledons* or *monocots.* Monocots include bananas, pineapples, and corn. Most bear leaves with parallel veins and flower parts in multiples of three. Angiosperms with two cotyledons are called *dicotyledons* or *dicots.* They produce leaves with a netlike pattern of veins and flower parts in multiples of four or five. Beans, squashes, and tomatoes are common dicots. *Gymnosperms* (nonflowering, woody plants) have embryos with two or more cotyledons, depending on the type of plant. Such needleleaf, cone-bearing trees as pines and hemlocks are gymnosperms.

Cotyledons have various functions. In some seeds, such as those of cereal grains, the cotyledon absorbs stored food from the *endosperm* (food storage tissue) of the seed. In other seeds, including those of peas and beans, the stored food is first absorbed by the developing embryo and then deposited in the fleshy cotyledons. When the seed of a pea sprouts, the cotyledons remain underground. In beans, however, the cotyledons appear above the ground and function briefly in *photosynthesis* (see **Photosynthesis**). Other cotyledons, such as those of morning-glories, resemble regular leaves in appearance and function. Joseph E. Armstrong

See also **Dicotyledon; Germination; Monocotyledon; Plant** (illustration: How a seed develops into a plant); **Seed** (illustration: The parts of a seed).

Cougar. See **Mountain lion.**

Cough is a strong, sudden expelling of air from the lungs. Coughing serves as a body defense that helps rid the lungs of harmful substances, such as pus or blood. But coughing also spreads germs that cause disease.

A person coughs if the lining of the respiratory tract becomes irritated. Certain nerves respond to this irritation, causing the individual to take a deep breath. These nerves also cause the *trachea* (windpipe) to close partially. The *diaphragm,* a large muscle that lies under the lungs, contracts rapidly, pushing air out of the lungs. The trachea then opens and the air rushes through the breathing passages and out of the mouth. The air carries along any substance in its path.

Irritants that produce coughing include smoking, air pollution, and respiratory infections. The irritation may lead to inflammation and cause the layer of mucus in the throat to thicken. Some cough medicines help reduce inflammation and loosen mucus so it can be coughed up easily. Others lessen the activity of certain nerves that produce coughing.

Mucus coughed up from the lungs helps physicians diagnose certain diseases. Doctors examine mucus under a microscope for evidence of bacteria, cancer cells, or other indication of disease. Barry L. Wenig

Coughlin, *KAWG lihn,* **Charles Edward** (1891-1979), was a Canadian-born Roman Catholic priest known for his political activities during the 1930's. Millions of Americans heard his weekly radio broadcasts and read his newspaper, *Social Justice.* Coughlin supported anti-Communism, anti-Semitism, isolation in foreign relations, and inflationary economic policies. His admiration for German dictator Adolf Hitler led his bishop to stop Coughlin's political activities after 1940. Coughlin was a parish priest in Royal Oak, Mich., from 1926 to 1966. He was born in Hamilton, Canada. David E. Kyvig

Coulee Dam. See **Grand Coulee Dam.**

Coulomb, *koo LAHM,* is a unit of electric charge in the metric system. Its symbol is C. The coulomb measures the amount of electricity flowing past a cross section of an electric circuit in one second when the current is one ampere. An electric current carrying one coulomb per second is called a current of one *ampere.* Ampere is the unit of rate or strength of flow. The name *coulomb* was given to the unit to honor the French physicist Charles Augustin de Coulomb. See also **Ampere; Farad.**

Leland F. Webb

Coulomb, *koo LAHM,* **Charles Augustin de,** *sharl oh goos TAN duh* (1736-1806), a French scientist, inventor, and army engineer, made fundamental contributions in the fields of friction, electricity, and magnetism. He formulated *Coulomb's law,* which states that the force between two electric or magnetic charges varies inversely as the square of the distance between them. He invented a number of instruments for measuring magnetic and electric forces. He also published papers on friction in machinery. The unit for the quantity of electricity, the coulomb, was named in his honor.

Coulomb was born in Angoulême. He was educated in Paris and entered the French Army. After nine years of army service in the West Indies, he devoted himself to scientific research. Richard G. Olson

Council, City. See **City government.**

Council of . . . See articles on councils listed under their key word, as in **Europe, Council of.**

Council on Foreign Relations is a private organization that studies problems in United States foreign

policy. The council aims to develop new approaches to, and an understanding of, international relations. It does not, however, support or oppose any course of action.

The council encourages the publication of books on foreign affairs. The authors of these books need not be council members. However, they receive advice from study groups made up of experts who are members. Since 1922, the council has published a quarterly magazine called *Foreign Affairs*.

The Council on Foreign Relations sponsors about 150 meetings yearly for members. Leading government officials and experts in foreign affairs address the meetings. The council offers fellowships to selected individuals to broaden their knowledge of foreign affairs.

The council was established in 1921 and has over 2,500 members. It selects members for their experience and interest in foreign affairs. More than 35 committees on foreign relations in cities throughout the United States are associated with the council. The Council on Foreign Relations has headquarters at 58 E. 68th Street, New York, NY 10021.

Critically reviewed by the Council on Foreign Relations

Counseling. See **Guidance; Psychotherapy.**

Counselor. See **Lawyer.**

Count is a title of honor going back to the days of the Roman Empire. The Latin word *comes* means *companion* or *follower,* and was used to indicate the companions of the Roman proconsuls. From this came the Spanish title *conde,* and the French *comte. Count* came into the English language as a translation of foreign titles equal to the English *earl.*

Counter Reformation, also known as the Catholic Reformation, generally refers to a period of Roman Catholic Church history in the 1500's and 1600's. The Counter Reformation consisted of two related movements: (1) a defensive reaction against the *Reformation,* a movement begun by Martin Luther in 1517 that gave birth to Protestantism, and (2) a Catholic reform.

Counteracting Protestantism. The Roman Catholic Church called the Council of Trent partly as a defense against Protestantism. The council met in sessions between 1545 and 1563 in Trent, Italy. It defined Catholic doctrine on questions disputed by Protestant theologians. The questions included original sin, grace, free will, the seven sacraments, the Mass, and the relation between Scripture and tradition. The council arranged for the pope to issue a catechism and books on *liturgy* (acts of worship), so there would be greater uniformity in church teachings. The church also published a list of books Catholics were forbidden to read because the books were considered harmful to faith or morals. In 1542, the church reorganized the Inquisition in Italy to help the courts fight Protestantism more effectively.

A number of wars resulting from religious conflicts broke out as Catholic governments tried to stop the spread of Protestantism in their countries. Such attempts led to civil war in France from 1562 to 1598 and rebellion in the Netherlands between 1565 and 1648. Religion was an issue in the fighting between Spain and England from 1585 to 1604. It was also a cause of the Thirty Years' War (1618-1648), which centered in Germany, but eventually involved most of the nations of Europe.

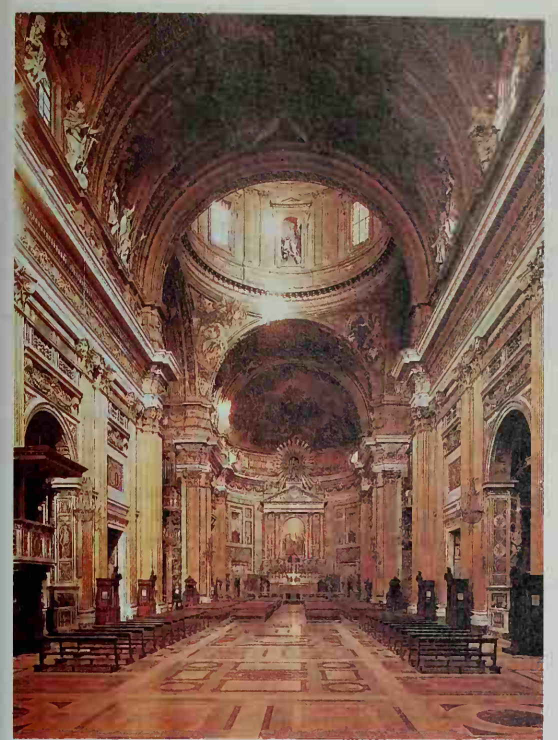
Catholic reform. The movement to reform the Roman Catholic Church started even before the Reformation. In Spain during the late 1400's and early 1500's, Cardinal Francisco Ximénes de Cisneros made efforts to end abuses that had developed in the church. The Council of Trent tried to stamp out abuses by the clergy. It ordered bishops to live in their dioceses, visit their parishes, and set up seminaries to train priests.

During the Counter Reformation, many religious orders experienced reform and considerable growth. The Capuchins played a major role in the renewal movement through their preaching. The Jesuits and the Dominicans led a revival of philosophy and theology at Catholic universities. Jesuit colleges trained many members of upper-class Catholic families in Europe. Prayer and religious devotion intensified. Books teaching meditation and personal reform, such as those by Saint Ignatius Loyola and Saint Francis de Sales, became popular.

The Louvre, Paris (Giraudon/Art Resource)



The Council of Trent was a key event of the Counter Reformation. Church leaders met in Trent, Italy, between 1545 and 1563 to define Catholic beliefs and to counteract Protestant teachings. The council also established many reforms in church practices. This painting by an unknown artist was completed about the time of the council.



Church (begun 1568) by Giacomo da Vignola and others; SCALA/Art Resource

The art of the Counter Reformation emphasized drama and emotion. The interior of the Church of the Gesù in Rome combined arches, columns, and sculpture to create a stirring feeling.

Large numbers of schools were set up in order to teach catechism.

Missionaries brought new peoples to Catholicism. Dominicans, Franciscans, Jesuits, and members of other orders worked among the inhabitants of Africa, Asia, and the Americas.

The Counter Reformation also affected art and literature. It inspired an enthusiasm and emotionalism that is represented, for example, in the works of the English poet Richard Crashaw in the mid-1600's. The Jesuits staged elaborate dramas at their colleges and influenced such artists as the Flemish painter Peter Paul Rubens and the Italian sculptor Gian Lorenzo Bernini.

John Patrick Donnelly

See also **Reformation; Roman Catholic Church** (The Counter Reformation); **Pope** (Renaissance and Reformation); **Trent, Council of; Baroque; Jesuits.**

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Counterfeiting is the unauthorized duplication of any object, especially money, with the intent to *defraud* (cheat someone). The printing and coining of money is the responsibility of national governments. In the United States, the Secret Service works to prevent the counterfeiting of U.S. currency.

The manufacture of imitation brand-name goods, including clothes, computers, and automobile parts, is called *trademark counterfeiting* or *pirating.* Counterfeit products are almost always inferior to the genuine products. Consumers are defrauded when they buy counterfeit goods, because they believe they are getting the real ones. The Trademark Counterfeiting Act of 1984 made it illegal to make or sell counterfeit goods.

George T. Felkenes

Counterpoint is a musical term for two or more independent melodies performed at the same time. Counterpoint is also called *polyphony.*

There are two basic types of counterpoint, *imitative* and *free.* In imitative counterpoint, a fragment of a theme called a *motive* is performed in different parts successively, often overlapping. The song "Three Blind Mice" is an example of imitative counterpoint called a *round.* Other examples include the *canon* and the *fugue* (see **Canon; Fugue**).

Free counterpoint combines two different melodies. In one type of free counterpoint, melodies are performed over a repeated pattern in the bass part. Compositions of this type include the *chaconne* and the *passacaglia.* In another type of free counterpoint, one melody is performed against a countermelody. The German composer Johann Sebastian Bach treated hymns in his chorale preludes in this style.

Counterpoint developed in Europe about A.D. 850. One peak in the use of counterpoint occurred in the 1500's in the works of William Byrd of England, Giovanni Palestrina of Italy, and the northern European composer Josquin Desprez. Another peak in the use of counterpoint occurred in the 1700's in the compositions of Bach.

R. M. Longyear

See also **Music** (Harmony).

Counting. See **Arithmetic.**

Country is a defined geographic territory under the authority of an independent government. The term may also be used to refer to the government of such a territory. A country may also be called a *nation* or a *state.* In 2002, there were 193 countries in the world, more than ever before.The number of countries has increased since the mid-1900's as more colonies have gained independence and large countries, such as the Soviet Union and Yugoslavia, have split up. In size, the countries of the world range from the Vatican City, which covers $\frac{1}{6}$ square mile (0.4 square kilometer), to Russia, which covers 6,592,850 square miles (17,075,400 square kilometers).

There are 9 huge countries in the world, each with an area of more than 1 million square miles (2.6 million square kilometers). There are 65 large countries with areas from 100,000 to 1 million square miles (260,000 to 2.6 million square kilometers). There are 30 countries with areas from 40,000 to 100,000 square miles (100,000 to 260,000 square kilometers), and 56 countries with areas from 3,000 to 40,000 square miles (7,800 to 260,000 square kilometers). Thirty-one small countries cover areas of less than 3,000 square miles (7,800 square kilometers) each.

For lists of the countries of the world, see **World** (table: Independent countries of the world). See also the various continent articles such as **Africa** (table: Independent countries). Kevin R. Cox

See also **Nation.**



Country Music Foundation



Popperfoto/Archive

Country music gained national popularity during the 1920's with recordings by string bands, such as the Dixie Mountaineers, *left,* led by country pioneer Ernest "Pop" Stoneman, *playing the guitar.* By the 1990's, such stars as Garth Brooks, *right,* had fans throughout the world.

Country music

Country music is a type of American popular music that developed in the Southern United States during the 1800's. Country music combines elements of British and Anglo-American folk music, the blues, religious music, and popular songs. Country music is sometimes called *country and western music.*

Country music was first recorded in the 1920's. At about the same time, radio stations across the United States began broadcasting country music radio programs. Radio and records greatly increased the popularity of country music, attracting fans from outside the South. Radio and records also led country music to interact with other forms of music. This interaction changed the character of country music. New instruments were introduced, and new styles emerged. The new styles combined country music with the sounds of jazz, rock 'n' roll, and pop music. These styles include bluegrass, Cajun, Western swing, and the Nashville Sound.

Over the decades, country music has evolved into one of the most important divisions of the American music industry. By the mid-1990's, country music had become more popular than at any other time in its history.

The characteristics of country music

Country music can be identified by its instrumentation, song lyrics, and vocal style.

The instruments used in country music vary with each style, but stringed instruments are common to nearly all country bands. The stringed instruments that made up the basic ensemble of early country music were the fiddle from Britain, the banjo from West Africa, the guitar from Spain, and the mandolin from Italy.

As country music came under the influence of other kinds of music, additional instruments were added. They included the Hawaiian steel guitar, the piano, the double bass, drums, and brass and reed instruments. Country musicians first played electrically amplified instruments in the 1930's. Today, amplified instruments dominate country recordings and live performances.

Country lyrics tell stories in clear, simple language. Most describe the common experiences of ordinary people. Many songs deal with love and romance. Some are happy songs, while others explore the loneliness and loss that result when love ends or when married couples are unfaithful. Some country songs have sacred themes, reflecting the historical importance of religion in Southern life. Other country songs offer advice on how life should be lived. They express sadness about the loss of a rural way of life and the loss of closeness among families and neighbors.

Some country songs, especially older ones, describe historical events or events in the news. For example, many country songs described wars and natural disasters, such as floods and shipwrecks. During the Great Depression, a worldwide economic slump in the 1930's, many country songs dealt with unemployment and homelessness. During World War II (1939-1945), some country songwriters wrote patriotic songs.

Vocal styles. Country performers sing in a clear voice and pronounce the words carefully, so listeners can understand the song. Performers also try to sing with sincerity to show they understand the meaning of each line. Many country performers sing in an accent associated with the speech of the Southern United States. For example, the high-pitched nasal accent spoken in the Appalachian Mountains became a prominent part of the singing styles of Bill Monroe and Dolly Parton.

Country singers are usually accompanied by a band. But some country singers, including Mary Chapin Carpenter and Garth Brooks, can perform alone and provide their own accompaniment, usually on guitar.

Varieties of country music

Country music is performed in a variety of styles, including *old-time, Western swing, cowboy, bluegrass, Cajun, honky-tonk, rockabilly,* and the *Nashville Sound.* Each style is characterized by its own instrumentation and its own approach to singing.

Old-time music is the oldest style of country music. It refers to the string bands and vocalists that were common when country music was first recorded in the 1920's. The most common instruments in old-time bands were the fiddle, banjo, and guitar. Many old-time songs are folk tunes drawn from the roots of country music. In the 1920's and 1930's, such bands as the Stoneman Family and the Skillet Lickers performed in old-time style. In

the 1960's, old-time music was revived by a group called the New Lost City Ramblers. In the 1990's and early 2000's, many young performers carried on the tradition of old-time music.

Western swing music developed in the 1920's and 1930's in Texas and Oklahoma. Western swing combines country music with big-band jazz music. Western swing bands feature fiddle, guitar, and steel guitar. They also include instruments common in jazz bands, including piano, trumpets, saxophones, and drums. Milton Brown and Bob Wills led popular Western swing bands in the 1930's and 1940's. In the 1990's, Johnny Gimble and the group Asleep at the Wheel performed Western swing.

Cowboy music became popular in the 1930's and 1940's, when singing cowboy movies were produced in Hollywood. Gene Autry, Tex Ritter, and Roy Rogers all had careers as country singers in addition to starring roles in cowboy movies. Most songs described life in the West. The singers were accompanied by guitar, and sometimes by accordion, fiddle, or harmonica. Professional music composers from Hollywood and New York City wrote most of the songs in cowboy movies.

Bluegrass music developed in the 1940's with the music of Bill Monroe and his group, the Blue Grass Boys. A typical bluegrass band includes guitar, banjo, fiddle, mandolin, and bass. Bluegrass groups also sometimes feature a kind of steel guitar called a *dobro.* Bluegrass music, like old-time music, remains close to the folk roots of country music. But bluegrass features complex vocal and instrumental solos and elaborate harmony singing. Bluegrass performers sing in a high-pitched, nasal style characteristic of the speech in eastern Kentucky and Tennessee. Lester Flatt and Earl Scruggs were important bluegrass performers from the 1940's through the 1960's. Alison Krauss and her group Union Station and the Nashville Bluegrass Band were major bluegrass groups in the 1990's.

Cajun music developed in southern Louisiana during the late 1800's and early 1900's. The term *Cajun* refers to French-speaking people from Canada who settled in Louisiana and Texas in the mid-1700's. The basic instruments in Cajun bands are the fiddle and accordion. Cajun bands also sometimes use triangles, guitars, and drums. Most Cajun songs are sung in French, and the music is frequently used to accompany dancing. Prominent performers of Cajun music included the group the Hackberry Ramblers during the 1930's and Harry Choates during the 1940's. Popular Cajun bands in the 1990's included Steve Riley and the Mamou Playboys and Beausoleil.

Honky-tonk music developed in Texas and Alabama in the late 1940's and early 1950's. This style took its name from small working-class nightclubs called *honky-tonks,* where the music was first performed. Honky-tonk music was louder and had a stronger beat than other types of country music. Honky-tonk bands expanded the role of amplified instruments in country music. Most honky-tonk songs tell sad stories about love and romance. Many describe how life's difficulties lead people to escape through drinking. Most honky-tonk singers write their own songs. Early honky-tonk stars, such as Hank Williams, Lefty Frizzell, and George Jones, are role models for Garth Brooks, Dwight Yoakam, and many other country performers in the 1990's and early 2000's.



Country Music Foundation

Bill Monroe, *left,* and the Blue Grass Boys pioneered bluegrass music in the 1940's. The band, shown at the Grand Ole Opry in 1947, included Lester Flatt, *center,* and Earl Scruggs, *right.*

Rockabilly music emerged in the mid-1950's in Memphis, Tennessee. This style combined country music with rock 'n' roll and rhythm and blues. Rockabilly instruments include electric guitar, bass, piano, and drums. Elvis Presley, Carl Perkins, and Jerry Lee Lewis were major rockabilly entertainers. Johnny Cash began his career as a rockabilly performer. Many country performers of the 1990's, including the Mavericks and Mark Collie, have been influenced by rockabilly music.

The Nashville Sound developed in Nashville, Tennessee, during the late 1950's and early 1960's. This style places country songs in musical settings associated with popular music. The singer's voice is full and smooth. The arrangements may include violin sections and background choruses. Record producers Chet Atkins, Owen Bradley, and Billy Sherrill shaped the Nashville Sound. Singers Eddy Arnold, Patsy Cline, and Jim Reeves also were associated with this style. In the 1970's and 1980's, Kenny Rogers, Barbara Mandrell, and Lee Greenwood made records in the Nashville Sound style.

History

The roots of country music. Country music developed during the 1800's in the South. Four types of music combined to form the basic sound of early country music: (1) folk ballads and fiddle tunes from Britain and Ireland, (2) blues of Southern blacks, (3) Southern religious music, and (4) American popular songs from the 1800's.

Beginning in the 1600's, immigrants from the British Isles brought their folk music to what is now the Southern United States. The music featured fiddling and singing. Solo fiddlers played dance music at social events, such as country dances and weddings. Ballads and other folk tunes were sung by one person, sometimes accompanied by a fiddle.

By the early 1900's, mail-order catalogs and traveling salesmen made guitars, banjos, and mandolins widely available to people in the rural South. These instruments combined with the fiddle to form the basic country string band.

British folk music blended with the religious music of the rural South. This religious music included hymns, and beginning in the late 1800's, gospel songs and spiri-

tuals. During the 1920's and 1930's, the Carter Family and the Stoneman Family played stringed instruments and sang gospel tunes as well as old love songs and folk ballads.

Because black people and white people lived close together in the Southern United States, they shared their traditional styles of music. Lyrics, song structure, and rhythmic guitar styles drawn from the blues music of African Americans are part of the folk heritage of country music. One of country music's first stars, Jimmie Rodgers, performed in a style influenced by black blues singers. Rodgers composed *blue yodels,* which combined story songs similar to British ballads with the mournful performance style of the blues.

During the late 1800's, printed sheet music and traveling tent shows brought popular music from Northern cities into the rural South. Such music was often called simply *pop music,* short for *popular music.* Most of the songs were published by one of the many music publishing companies that lined Tin Pan Alley in New York City.

When country music was first recorded in the 1920's, musicians performed pop tunes, such as "The Baggage Coach Ahead," along with folk songs and blues numbers. Vernon Dalhart, one of country music's first stars, began his career as a pop singer with training in opera. One of Dalhart's hit records had an authentic folk song, "The Wreck of Old 97," on one side and a sentimental pop tune, "The Prisoner's Song," on the flip side. Ever since, country music has been strongly affected by mainstream pop music. This influence has occurred despite the objection of some country fans and performers who feel that country music loses its rural, Southern identity when it sounds too much like pop music.

Early commercial success. During the 1920's, the rapid development of radio and the recording industry transformed country music from an informal folk art into part of the American entertainment industry. Powerful radio stations broadcast country music throughout the United States. Records enabled musicians to hear a performance over and over to study lyrics and method of playing.

In 1924, radio station WLS in Chicago began broadcasting a live program of music and comedy. Most of the music was country. The program was later called "The National Barn Dance." In 1925, WSM in Nashville began a similar radio program called "The WSM Barn Dance." George D. Hay hosted this program, which he renamed "The Grand Ole Opry" in 1927. During the 1920's and 1930's, live country radio programs broadcast from many U.S. cities, including Atlanta, Georgia; Cincinnati, Ohio; Fort Worth, Texas; and Wheeling, West Virginia.

Each country music radio program ran for two to three hours, usually one or two nights each week. The programs featured string bands, fiddlers, and guitar and piano soloists, as well as comedians and rural poets. All the programs included advertisements for products of interest to people living in rural areas. Most shows were performed in front of a live studio or theater audience. The radio stations were powerful, and no other station was allowed to broadcast on their assigned frequencies. Therefore, the programs could be heard many miles from their station of origin. Nashville's "The Grand Ole Opry," for example, could be heard from Florida to southeastern Canada.

Radio shows provided employment for country singers and their bands and allowed them to be heard across the country. Performers could sing their latest record release, stimulating record sales. Performers could also encourage concert ticket sales by telling listeners where and when they would be performing.

Country music became available on records about the same time that country radio shows appeared. Most record companies were in New York City. Country musicians sometimes traveled north to record in New York studios. The first country recording, Eck Robertson's rendition of the old-time fiddle tune "Sallie Goodin," was recorded in New York City on June 30, 1922. Vernon Dalhart lived in the North and did all of his recording in New York City.

Sometimes record producers traveled to the South on field trips to record music. Producers set up temporary studios and used portable recording equipment. Ralph Peer and Arthur E. Satherley were record producers from New York City who pioneered field recording of country music. Peer discovered Jimmie Rodgers and the Carter Family at a two-week field recording session in 1927 in Bristol, a Tennessee-Virginia border town.

With radio and records, country musicians could listen to jazz, Hollywood movie music, and other types of music that were popular outside of the rural South. Country performers and songwriters soon began to incorporate these styles into their music. As a result, several important styles of country music developed during the 1930's. Gene Autry, who had appeared on the WLS "National Barn Dance," made his first singing cowboy film in 1935. Bob Wills began recording Western swing music in 1935. In 1939, Bill Monroe formed the Blue Grass Boys, marking the birth of bluegrass music. Meanwhile, such bands as the Carter Family kept the folk tradition alive. The Carter Family recorded such love songs as "Wildwood Flower," and songs of inspiration, such as "Will the Circle Be Unbroken."

Country music continued to grow in popularity during the Great Depression. Country radio programs provided free entertainment and helped lighten the burden of hard times. Record companies introduced inexpensive lines of country recordings so fans could buy records when money was scarce.

Emergence of the country music industry. World War II produced changes in American society that had an impact on country music. During the war, many rural Southerners left their farms to move close to factories in big cities. In addition, Southern men traveled to Europe and Asia with the United States military forces. These transplanted Southerners carried their records and taste for country music with them. The number of country fans outside the Southern United States grew even larger, and country music made new fans overseas.

Country music began to reflect its changed audience. For example, honky-tonk music, which emerged soon after the war, was associated with displaced rural people. Honky-tonk songs rarely dealt with farm life. Rather, they described the problems of working-class Americans, including broken marriages, troubled families, and alcoholism.

During the 1940's, Nashville began to emerge as a

center for country music. "The Grand Ole Opry" became the most important country music radio show, and country music publishing became an important Nashville business. Roy Acuff, who joined the Opry in 1938, was its biggest star in the 1940's and 1950's.

In 1943, Acuff and songwriter Fred Rose formed Acuff-Rose Publishing in Nashville. In 1946, Acuff-Rose signed Hank Williams as a songwriter. Williams, who was also a singer, made hit recordings of his own songs. Many of Williams's songs, including "Your Cheatin' Heart" and "Cold, Cold Heart," were also hits when recorded by pop singers. Although Hank Williams died in 1953 when he was only 29 years old, he is considered the most influential singer and songwriter in country music history.

In the mid-1950's, rock 'n' roll emerged and captured much of the country music audience. Rockabilly music had close ties to traditional country music. Still, such performers as Elvis Presley and Jerry Lee Lewis took fans away from more traditional honky-tonk and bluegrass artists, such as Lefty Frizzell, Lester Flatt, and Earl Scruggs. For the remainder of the decade, country music tried to regain the fans it had lost.

To increase the exposure of country music, record companies and radio stations aggressively promoted country singers and songwriters. The Country Music Association (CMA) was formed in 1958 to promote country music. The CMA organized concerts in big cities and initiated an annual country music awards show.

In the late 1950's and early 1960's, the Nashville Sound developed. This style combined country music with elements of pop music to create a sound that had broad commercial appeal. A small pool of talented instrumentalists, called *session musicians,* played on nearly all country records cut in Nashville. These musicians developed a relaxed approach to performing that did not require written music. Guitarist and producer Chet Atkins and pianist Floyd Cramer were top session musicians.

Many Nashville singers, including Eddy Arnold, Patsy Cline, and Jim Reeves, recorded songs that were hits with both country and pop fans. Such recordings were called *crossover hits,* because they crossed over from one type of music to another. Reeves's "He'll Have to Go," Cline's "Crazy," and Arnold's "Make the World Go Away" were major crossover hits in the Nashville Sound style.

By 1965, country music had regained the audience it had lost to rock 'n' roll, and had attracted new fans. The promotional work of the CMA and the popularity of "The Grand Ole Opry" and the Nashville Sound ensured the renewed success of country music.

Modern country music. The 1960's were years of expansion and prosperity for the country music industry. Many new recording studios and record companies were opened. Loretta Lynn and Tammy Wynette became popular during the 1960's, bringing new prominence to the role of women in country music.

Nashville continued to dominate as a center for country music recording, publishing, and songwriting. During the late 1960's, most country recordings contained elements of the Nashville Sound. Only Bakersfield, California, home to Merle Haggard and Buck Owens, competed with Nashville as a center for country music recording and songwriting.

By the mid-1970's, some people in the country music business had grown tired of the Nashville Sound. The same session musicians played on nearly every recording, and many felt that their work was no longer creative. Many country fans and performers felt that Nashville music had become too close to mainstream pop music.

Some country musicians, notably Willie Nelson, Waylon Jennings, and the Glaser Brothers, rejected the conservative Nashville Sound. These singers and songwriters were called *outlaws.* The outlaws began to make records in Austin, Texas. They often recorded with members of their touring bands rather than with session musicians. More importantly, the outlaws returned to earlier, more traditional styles of country music. Many outlaws, including Willie Nelson and Waylon Jennings, performed in honky-tonk style. Others, such as Emmylou Harris, performed in an updated bluegrass style.

The outlaws began a process of change in country music that continued into the 1990's. Much country mu-



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Hank Williams, a popular singer and songwriter of the 1940's and early 1950's, was one of country music's most influential artists. His music inspired new traditionalist singers in the 1990's.



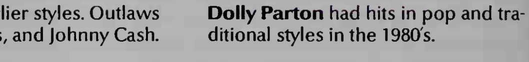
Country Music Foundation

Patsy Cline helped shape the Nashville Sound in the late 1950's. She is shown above at a recording session with leading Nashville producers Owen Bradley, *left,* and Paul Cohen, *right.*



Country Music Foundation

The "outlaws" of the 1970's rejected the Nashville Sound in favor of earlier styles. Outlaws included, *left to right,* Willie Nelson, Kris Kristofferson, Waylon Jennings, and Johnny Cash.



Mark Serota, LGI

Dolly Parton had hits in pop and traditional styles in the 1980's.

sic in the late 1970's and 1980's resembled country music of the 1950's, before the Nashville Sound had emerged. Despite the influence of the outlaws, some country singers, including Barbara Mandrell, Lynn Anderson, and Lee Greenwood, recorded hit songs that were pop in style. Some performers, such as Dolly Parton and Kenny Rogers, made records in both traditional country and pop styles. Rogers, for example, recorded such country songs as "Lucille" and "The Gambler," as well as pop hits, including "You Decorated My Life."

In the late 1980's and early 1990's, a number of young country performers came to prominence who had been influenced by the outlaws. These performers were called *new traditionalists.* They rejected musical influences that had made country music sound like pop music and returned to the styles of earlier years.

Many new traditionalists drew upon the music of Hank Williams and other honky-tonk performers of the 1950's. Garth Brooks, Randy Travis, and Dwight Yoakam were prominent new traditionalists who performed in a honky-tonk style. Randy Travis sang heartfelt love songs, such as "On the Other Hand," in the manner of honky-tonk singers Lefty Frizzell and Merle Haggard. New traditionalist George Strait evoked Western swing with such recordings as "All My Ex's Live in Texas." Singer and songwriter Ricky Skaggs demonstrated the influence of bluegrass music in such songs as "Don't Get Above Your Raisin'."

One of the most popular new traditionalists was singer and songwriter Garth Brooks. Brooks achieved dramatic success with radio, recordings, and live performances. He combined a honky-tonk singing style with elaborate stage shows similar to those in rock music. Brooks wrote realistic songs about everyday life. Some of his songs, such as ""The Thunder Rolls" and ""We Shall Be Free," discussed political and social problems.

Like Garth Brooks, many country performers of the 1990's and early 2000's, including Clint Black, Alan Jackson, and Reba McEntire, combined styles from country music's past with modern music videos and stage pro-



Donna Driesel, Retna



Beth Gwinn, Retna



Beth Gwinn, Retna

Country stars of the 1990's, including Alan Jackson, *left,* Reba McEntire, *center,* and Clint Black, *right,* combined styles from country music's past with modern music videos and stage shows. Country music became more popular in the 1990's than at any other time in its history.

ductions. As a result, country music had more fans and sold more recordings in the mid-1990's than at any other time in its history. Paul F. Wells

Related articles in *World Book* include:

Acuff, Roy	Cash, Johnny	Popular music
Arnold, Eddy	Cline, Patsy	Ritter, Tex
Atkins, Chet	Folk music	Rodgers, Jimmie
Autry, Gene	Grand Ole Opry	Rogers, Roy
Brooks, Garth	Monroe, Bill	Williams, Hank
Carter family	Parton, Dolly	

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County is usually a division of local government. Almost all the states of the United States are divided into counties. Louisiana has divisions called *parishes,* which correspond to counties. Alaska has similar divisions called *boroughs.* Connecticut is divided into eight counties used only for the election of sheriffs, and Rhode Island is divided into five counties that serve only as divisions of the state court system. All other U.S. states have county governments. The form of county organization and the number and powers of county officers vary from state to state. State legislatures set county boundaries.

Importance. The county is an important part of local government in all regions of the United States except New England. In New England, the *town* is the center of local influence (see **Town**). In the Midwest and in the Middle Atlantic States, most counties share authority with *townships* (see **Township**). County revenues are raised chiefly by taxes on personal property and on real estate. State governments contribute some state-collected taxes to counties.

The number and size of counties vary from state to state and from region to region. The United States has 3,042 organized counties. Texas, with 254, has more counties than any other U.S. state.

Forms of county governments. Most county governments have a *decentralized* administration, with no executive head. The main county institution is an elective board that, in most cases, is called a *board of commissioners* or *board of supervisors.* It consists of from 1 to more than 100 members. The members of some boards are elected at large. The members of other boards are elected from districts, wards, or townships. Most county officers serve terms of from 2 to 4 years. They may include county commissioners or supervisors, sheriff, district attorney, medical examiner or coroner, registrar of wills, recorder of deeds, clerk of courts, jury commissioner, controller or auditor, treasurer, assessor, and others.

Some counties, especially urban counties, have an executive office that controls all other county offices. The executive office is headed by an elected county executive or by an administrator or manager appointed by the elective board.

Duties. County governments may administer justice, assess and collect taxes, record official documents, and register voters. They may also administer roads, public education, zoning, and licensing. Some counties manage such functions as sewage disposal, jails, and relief systems. Some maintain parks, airports, hospitals, libraries, electric service, and water service.

In counties where large cities occupy the entire county area, city and county governments may form a single unit. Denver, Honolulu, and San Francisco, for example, have combined city and county governments. In counties that are only partly covered by a city, the city and county may share responsibility for providing services to county residents. In Miami-Dade County, Florida, for example, the city of Miami provides police and fire protection to its own residents. But Miami-Dade County furnishes such protection to many county residents who live outside Miami. Such cities as Baltimore and Roanoke, Virginia, are not part of any county and do not form a part of county government. In these cities, municipal officials perform many of the duties that are ordinarily handled by county officials.

History. The word *county* comes from a French word that means *domain of a count.* The English, influenced by the French, began to call their *shires* counties about 1400. The English colonists brought the county system with them to America. Susan H. Ambler

See also **County agricultural extension agent; District attorney; Sheriff.**

County agricultural extension agent is a public official who helps farmers, families, and communities solve agricultural and family-living problems. Nearly every county in the United States has at least one agent. Agents are part of the Cooperative Extension System, a partnership of the federal, state, and county governments. Agents are officially known as *agent/educators.*

County agricultural extension agents work to help farmers improve their farming and financial management practices. They advise all farmers, regardless of the size of the farm. In both rural and urban areas, agents advise volunteer 4-H leaders and provide information about gardening and insect control.

The agents also work with local leaders to improve rural communities. For example, they help develop plans to control pollution and try to make more jobs available for local people. Many agents have a bachelor's degree in some field of agriculture.

Critically reviewed by the Department of Agriculture

See also **Agricultural education; Farm and farming** (Obtaining management assistance); **4-H; Gardening** (Planning the garden).

Coup d'état, *koo day TAH,* is a sudden take-over of a country's government by a group of conspirators. Usually, the conspirators are public officials who infiltrate and then use their country's armed forces, police, and communications to seize power. A coup d'état may lead to few or many changes in the government. Famous coups in history include those carried out by Napoleon Bonaparte in France in 1799, by the Bolsheviks in Russia in 1917, and by the Communists in Czechoslovakia in 1948. Since 1900, most coups have occurred in politically unstable countries in Africa, Asia, Latin America, and the Middle East. *Coup d'état* is a French term meaning *stroke of state.* Stephen Goode

See also **Junta.**

Couperin, *koo PRAN,* **François** (1668-1733), called "Le Grand" (The Great), was a French composer during the Baroque period. Much of his work was written for

the *harpsichord,* a keyboard instrument resembling a piano, in which the strings are plucked. For this instrument, Couperin wrote 27 *ordres* (suites) containing more than 200 highly imaginative, picturesque, and elegant pieces. Johann Sebastian Bach studied and sometimes imitated Couperin's style. Couperin also wrote chamber music and church music. In 1716, he published a harpsichord instruction book that is still used by students of the instrument.

Couperin was born in Paris. Many members of his family were also musicians. He became organist at the church of St. Gervais in 1688 and at the royal chapel in 1693. He often performed on the harpsichord before the royal court at Versailles, and he was music teacher to the children of King Louis XIV. Joscelyn Godwin

Couplet, *KUHP liht,* is a rhyme of two lines. The *heroic couplet* is an English metrical form in iambic pentameter, used in sequence.

A *closed* couplet emphasizes the rhyme, and completes a thought within two lines. For example:

> A perfect Judge will read each work of Wit
> With the same spirit that its author writ:
> Survey the Whole, nor seek slight faults to find
> Where nature moves, and rapture warms the mind . . .

In an *open* couplet, clauses and sentences end anywhere, and the rhyme is not emphasized. For example:

> A thing of beauty is a joy forever:
> Its loveliness increases; it will never
> Pass into nothingness; but still will keep
> A bower quiet for us, and a sleep
> Full of sweet dreams, and health, and quiet breathing.

John Dryden and Alexander Pope used the closed couplet brilliantly. Other poets used open couplets with great skill. They include Geoffrey Chaucer, George Chapman, and John Keats. The word *couplet* also refers to any two lines of poetry that stand alone to form a stanza. Paul B. Diehl

See also **Meter; Poetry; Rhyme.**

Courbet, *koor BEH,* **Gustave** (1819-1877), a French painter, helped found the realist movement in art. When Courbet began his career, the dominant art styles in France were neoclassicism and romanticism. Neoclassical artists chiefly portrayed historical subjects in a classical style. Romantic artists stressed dramatic and exotic themes. Courbet believed art should show the people and events of the time realistically and honestly, without seeking to idealize or dramatize.

In 1850, Courbet created great controversy when he exhibited two of his most important paintings, *A Burial at Ornans* and *The Stone Breakers.* These paintings portray rural society in its native setting. Many urban viewers objected to Courbet's perceptive treatment of rural people. Painters of the time had been portraying these people sentimentally or as inferior to the urban middle and upper classes. In *A Burial at Ornans,* Courbet painted the peasants and clergy life-sized. During this period, the peasants had become an important political force. Courbet's portrayal of this new force disturbed conservative critics.

Jean Désiré Gustave Courbet was born in Ornans, near Besançon. In 1840, he moved to Paris. Courbet sympathized with revolutionary movements devoted to ending the French monarchy. He supported the Revolution of 1848. Later, he became a member of the Commune, which governed Paris briefly in 1871. After the Commune fell, Courbet was imprisoned and fined for his political activities. In 1873, he went into exile in Switzerland. Courbet's paintings influenced such major art movements as naturalism and impressionism.

Richard Shiff

See also **Painting** (Realism).

Coureurs de bois, *koo RUR duh BWAH,* were French-Canadian frontiersmen of the late 1600's and the early 1700's who made their living by trading for furs with the Indians. At that time, Canada was a colony of France, and private fur traders were required to get a license from the government at Quebec. The government issued very few licenses, and most coureurs de bois traded illegally. *Coureurs de bois* means *vagabonds of the forest.* The adventurous life attracted many young men who had become bored with farming.

The coureurs de bois sold brandy to the Indians, and the missionaries frowned on their activities. However, these adventurers learned Indian languages and customs. As a result, the coureurs de bois provided a link between the Indians and the French that helped cement the alliance against the English in the French and Indian wars. P. B. Waite

Courser is the name for a group of desert birds found in Africa, India, and Australia. Most coursers have long legs and short wings. They are normally seen running swiftly over the sand. They seldom fly unless disturbed

Oil painting on canvas (1850); the Louvre, Paris (Art Resource)



A Courbet painting called *A Burial at Ornans* shows about 40 life-sized figures attending a burial in rural France. The painting caused great controversy when it was first exhibited. Critics objected to the sympathetic portrayal of common villagers. Most people believed only important individuals deserved to be represented on such a grand scale.



J. Robert, Jacana

Coursers are swift-running desert birds found in Africa, India, and Australia. The Egyptian plover, *above,* is a courser that lives along the Nile River in Egypt.

and then usually fly only a short distance. Coursers feed chiefly on insects.

There are nine species of coursers, most of which are brown and white. One species, the Egyptian plover, has bright gray, white, and black markings. The Egyptian plover is common along the Nile River. It is also called the *crocodile bird* because in folk tales the bird is described picking bits of food out from between a crocodile's teeth. The female Egyptian plover incubates her eggs at night and often buries them in the sand during the day to be heated by the sun. In southern Africa, coursers are noted for eating large numbers of locusts and are sometimes called *locust birds.*

Scientific classification. Coursers belong to the family Glareolidae. The Egyptian plover is *Pluvianus aegyptius.*

Donald F. Bruning

Court is a government institution that settles legal disputes and administers justice. Courts resolve conflicts involving individuals, organizations, and governments. Courts also decide the legal guilt or innocence of persons accused of crimes and sentence the guilty.

All courts are presided over by judges. These officials decide all questions of law, including what evidence is fair to use. In many cases, the judge also decides the truth or falsity of each side's claims. In other cases, a jury decides any questions of fact. The word *court* may refer to a judge alone or to a judge and jury acting together. It also may refer to the place where legal disputes are settled.

Some court rulings affect only the persons involved in a case. Other decisions deal with broad public issues, such as freedom of the press, racial discrimination, and the rights of persons accused of a crime. In this way, courts serve as a powerful means of social and political change.

Types of courts

Courts differ in their *jurisdiction* (authority to decide a case). Generally, courts are classified as *trial courts* or *appellate courts,* and as *criminal courts* or *civil courts.*

Trial and appellate courts. Nearly all legal cases begin in trial courts, also called *courts of original jurisdiction.* These courts may have general jurisdiction or limited, also called *special,* jurisdiction. Courts of general jurisdiction hear many types of cases. The major trial court of any county, state, or other political unit is a court of general jurisdiction. Courts of limited or special jurisdiction specialize in one or more types of cases, such as those involving juvenile offenders or traffic violations.

The losing side often has the right to *appeal*—that is, to ask that aspects of the case be reconsidered by a higher court called an appellate or *appeals court.* Appellate courts review cases decided by trial courts if the losing side questions the ruling of the lower court on a matter of law. Appellate courts cannot review a trial court's decision on the facts.

Criminal and civil courts. Criminal courts deal with actions considered harmful to society, such as murder and robbery. In criminal cases, the government takes legal action against an individual. The sentences handed down by criminal courts range from probation and fines to imprisonment and, in some states, death.

Civil courts settle disputes involving people's private relations with one another. Civil suits involve such noncriminal matters as contracts, family relationships, and accidental injuries. In most civil cases, an individual or organization sues another individual or organization. Most civil decisions do not involve a prison sentence, though the party at fault may be ordered to pay damages.

How courts work

How criminal courts work. Most persons arrested on suspicion of a crime appear before a judge called a *magistrate* within 24 hours after the arrest. In cases involving minor offenses, the magistrate conducts a trial and sentences the guilty. In more serious cases, the magistrate decides whether to keep the *defendant* (accused person) in jail or to release him or her on bail. The magistrate also may appoint a state-paid defense attorney, called a *public defender,* to represent a defendant who cannot afford a lawyer.

Pretrial proceedings. In a case involving a serious crime, the police give their evidence of the suspect's guilt to a government attorney called a *prosecutor.* In some states, the prosecutor formally charges the defendant in a document called an *information.* The prosecutor presents the information and other evidence to a magistrate at a *preliminary hearing.* If the magistrate decides that there is *probable cause* (good reason for assuming) that the defendant committed the crime, the magistrate orders the defendant held for trial. In other states and in federal courts, the prosecutor presents the evidence to a *grand jury,* a group of citizens who decide whether the evidence justifies bringing the case to trial. If the grand jury finds sufficient evidence for a trial, it issues a formal accusation called an *indictment* against the suspect.

The defendant then appears in a court of general jurisdiction to answer the charges. This hearing is called an *arraignment.* If the defendant pleads guilty, the judge pronounces sentence. Many defendants plead guilty, rather than go to trial, in return for a reduced charge or a shorter sentence. This practice is called *plea bargaining.* Most criminal cases in the United States are settled in this way. But if the accused pleads not guilty, the case goes to trial.

Trial. The defendant may request a jury trial or a *bench trial,* which is a trial before a judge. The jury or judge must decide if the evidence presented by the prosecutor proves the defendant guilty "beyond a reasonable doubt." If not, the defendant must be *acquitted* (found not guilty).

If the defendant is found guilty, the judge pronounces sentence. Convicted defendants may take their case to an appellate court. However, prosecutors may not appeal an acquittal because the United States Constitution forbids the government to *put a person in double jeopardy* (try a person twice) for the same crime.

How civil courts work. A civil lawsuit begins when an individual or organization, called the *plaintiff,* files a complaint against another individual or organization, called the *defendant.* The complaint formally states the injuries or losses the plaintiff believes were caused by the defendant's actions. The complaint also asks for a certain amount of money in damages.

The defendant receives a *summons,* a notice that a complaint has been filed. It directs the defendant to appear in court on a certain date. The defendant then files a document called an *answer.* The answer contains the defendant's version of the facts of the case and asks the court to dismiss the suit. The defendant also may file a *counterclaim* against the plaintiff.

In most cases, the complaint and the answer are the first of a series of documents called the *pleadings.* In the pleadings, the plaintiff and defendant state their own claims and challenge the claims of their opponents. Most civil cases are settled out of court on the basis of the pleadings. However, if serious questions of fact remain, a formal *discovery* takes place. This procedure forces each *litigant* (party involved in the case) to reveal the testimony or records that would be introduced as evidence in court. If the case still remains in dispute after the discovery, it goes to trial.

Civil cases may be decided by a judge or by a jury. The judge or jury determines who is at fault and how much must be paid in damages. Both sides may appeal.

Courts in the United States

The United States has a dual system of federal and state courts. Federal courts receive their authority from the U.S. Constitution and federal laws. State courts receive their powers from state constitutions and laws.

Federal courts handle both criminal and civil cases involving the Constitution or federal laws, and cases in which the U.S. government is one of the sides. They also try cases between individuals or groups from different states, and cases involving other countries or their citizens. They handle *maritime* (sea) cases, bankruptcy actions, and cases of patent and copyright violation.

The federal court system includes district courts, courts of appeals, and the Supreme Court of the United States. District courts are federal courts of *original jurisdiction*—that is, they are the first courts to hear most cases involving a violation of federal law. The United States and its possessions have about 95 district courts. Each state has at least one such court.

Courts of appeals try federal cases on appeal from district courts. They also review the decisions made by such federal agencies as the Securities and Exchange Commission and the National Labor Relations Board. The United States is divided into 12 *circuits* (districts), each of which has a court of appeals. An additional federal court of appeals, the United States Court of Appeals for the Federal Circuit, has nationwide jurisdiction.

The Supreme Court of the United States is the highest court in the nation. A person who loses a case either in a federal court of appeals or in the highest state court may appeal to the Supreme Court, but it may refuse to review many cases. In addition to its appellate jurisdiction, the court has original jurisdiction over cases involving two states or representatives of other countries.

The federal court system also includes several specialized courts. The United States Court of Federal Claims hears cases involving claims against the federal government. The Court of International Trade settles disputes over import duties. Taxpayers ordered to pay additional federal income taxes may appeal to the Tax Court of the United States. Military courts, called *courts-martial,* have jurisdiction over offenses committed by members of the armed forces. The Court of Military Appeals reviews court-martial rulings.

State courts. The lowest state courts are courts of limited or special jurisdiction. Some of these courts handle a variety of minor criminal and civil cases. Such courts include *police courts, magistrate's courts,* or *county courts,* and *justices of the peace.* Other lower courts specialize in only one type of case. For example, *small-claims courts* try cases that involve small amounts of money. *Probate* or *surrogate courts* handle wills and disputes over inheritances. Other specialized courts include *courts of domestic relations, juvenile courts,* and *traffic courts.*

Courts of general jurisdiction rank above courts of limited jurisdiction. These higher courts are known as *circuit courts, superior courts,* or *courts of common pleas.* About half the states have intermediate appeals courts, which hear appeals from courts of general jurisdiction. In some states, courts of general jurisdiction and appellate courts handle both criminal and civil cases. Other states have separate divisions on both levels. The highest court in most states is its supreme court.

Courts around the world

Courts in other countries. The judicial systems of most countries are based on either *common law* or *civil law.* Some combine the features of both systems. This use of the term *civil law* refers to a legal system. It should not be confused with the branch of law dealing with people's private relations with one another.

In common-law systems, judges base their decisions primarily on *precedents,* earlier court decisions in similar cases. Most English-speaking countries, including the United States, the United Kingdom, Canada, and Australia, have common-law systems.

Civil-law systems rely more strictly on written *statutes* (legislative acts). Judges may refer to precedents, but they must base every ruling on a particular statute and not on precedent alone. Most European, Latin-American, and Asian countries, and some African nations, have civil-law systems.

International courts deal with disputes between nations. The International Court of Justice, a body of the United Nations (UN), meets at The Hague in the Netherlands. Its decisions are not binding unless the nations in-

United States court system

The U.S. court system has two levels—state and federal. State courts handle cases that affect state constitutions and laws. Federal courts hear cases that involve the U.S. Constitution and federal laws, plus cases in which the U.S. government is one of the sides.

WORLD BOOK illustrations by Bill and Judie Anderson

Civil or Criminal Cases → Courts of Limited Jurisdiction → Ruling

DECISION

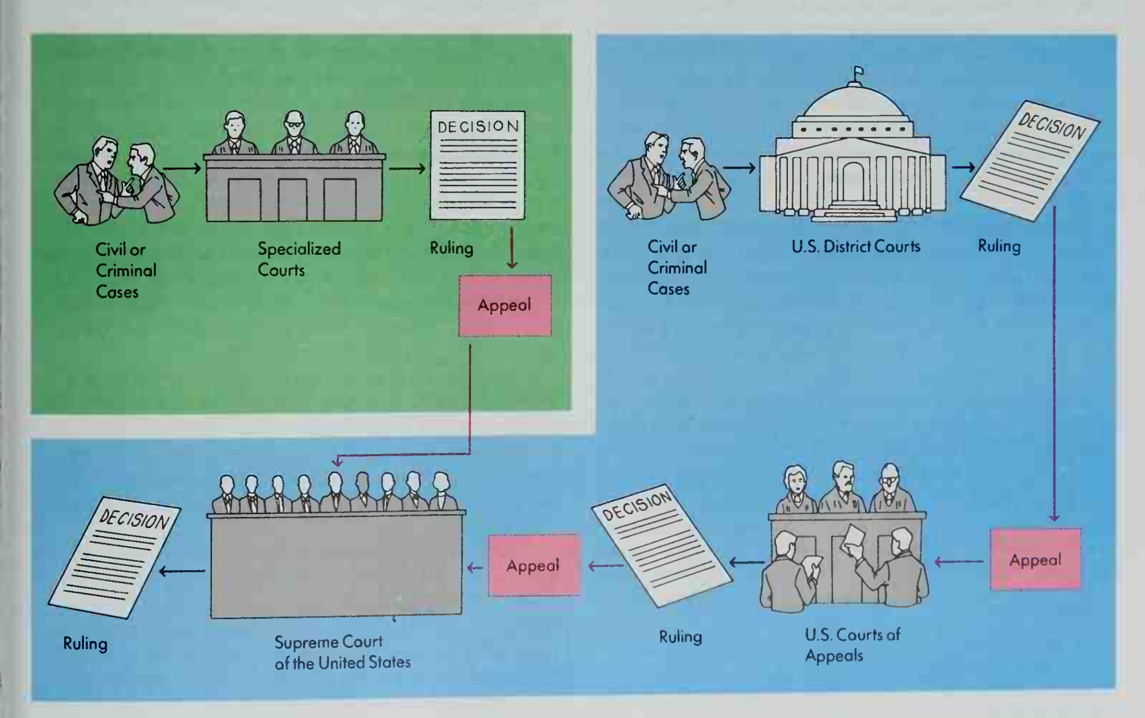
Civil or Criminal Cases → Courts of General Jurisdiction → Ruling

DECISION

Appeal → Intermediate Appellate Courts → Ruling → Appeal → State Supreme Court → Ruling

DECISION

State courts vary according to their authority. Courts of limited jurisdiction decide minor cases. Courts of general jurisdiction hear more serious cases. These cases may be appealed to intermediate appellate courts, if the state has them, or go directly to the supreme court of the state.



Federal courts include district courts, courts of appeals, and the Supreme Court of the United States. The federal system also has several specialized courts. The Supreme Court of the United States may review cases from state supreme courts if a question of federal law is involved.

volved in the dispute agree to accept its rulings. In 1998, 120 UN member nations voted to approve a treaty calling for the establishment of another UN court, the International Criminal Court (ICC), for the prosecution of war crimes and other offenses

History

Early courts. Tribal councils or groups of elders served as the first courts. They settled disputes on the basis of local custom. Later civilizations developed written legal codes. The need to interpret these codes and to apply them to specific situations resulted in the development of formal courts. For example, the ancient Hebrews had a supreme council, called the *Sanhedrin,* which interpreted Hebrew law.

The ancient Romans developed the first complete legal code as well as an advanced court system. After the collapse of the West Roman Empire in the A.D. 400's, the Roman judicial system gradually died out in western Europe. It was replaced by *feudal* courts, which were conducted by local lords. These courts had limited jurisdiction and decided cases on the basis of local customs.

Development of civil-law and common-law courts. During the early 1100's, universities in Italy began to train lawyers according to the principles of ancient Roman law. Roman law, which relied strictly on written codes, gradually replaced much of the feudal court system throughout mainland Europe. In the early 1800's, the French ruler Napoleon I used Roman law as the foundation of the *Code Napoléon.* This code, a type of civil law, became the basis of the court system in most European and Latin American countries.

By the 1200's, England had established a nationwide system of courts. These courts developed a body of law that was called *common law* because it applied uniformly to people everywhere in the country. Common-law courts followed traditional legal principles and based their decisions chiefly on precedents. English common law became the basis of the court system for most countries colonized by England, including the United States and Canada.

Development of U.S. courts. The American Colonies based their courts on the English common-law system. These colonial courts became state courts after the United States became an independent nation in 1776. Only Louisiana modeled its court system on civil law. In 1789, Congress passed the Judiciary Act, which created the federal court system. Jack M. Kress

Related articles in *World Book.* For information on the courts of various states, provinces, and countries, see the *Government* section of those articles. See also:

Courts

Court-martial
Court of appeals
Court of claims
Court of International Trade, United States
Court of Military Appeals, U.S.
District court
International Court of Justice
Juvenile court
Small-claims court
Supreme Court of the United States

Officials

Chief justice
Clerk of court
District attorney
Grand jury
Judge
Jury
Justice of the peace
Lawyer
Marshal
Public defender

Procedures and documents

Affidavit
Appeal
Attachment
Bail
Brief
Class action
Deposition
Equity
Evidence
Fine
Forfeiture
Garnishment
Habeas corpus
Indictment
Injunction
Inquest
Judicial review
Mandamus
Oath
Petition
Plea bargaining
Restraining order
Sentence
Subpoena
Suit
Summons
Trial
Warrant
Witness
Writ

Other related articles

Civil law
Code Napoléon
Common law
Criminal justice system
Judicial Conference of the United States
Kangaroo court
Law
Law enforcement
Old Bailey
Star Chamber

Additional resources

Barnes, Patricia G. *Congressional Quarterly's Desk Reference on American Courts.* Congressional Quarterly, 1999.
Mikula, Mark F., and others, eds. *Great American Court Cases.* Gale, 1999.

Court, Margaret Smith (1942-), an Australian tennis star, was one of the best female tennis players in history. She was rated among the world's top 10 female tennis players from 1961 to 1975, ranking number one seven times. Court was noted for her endurance and control, as well as her skill at blending power and delicacy in her shots.

In 1970, Court won the *grand slam* of tennis in singles competition—the Australian Open, the French Open, the United States Open, and Wimbledon. Maureen Connolly and Steffi Graf are the only other women to win the grand slam in singles. Court also won the grand slam in mixed doubles in 1963. Her career record of 64 titles in the four grand slam tournaments consisted of 24 in singles, 21 in women's doubles, and 19 in mixed doubles.

Margaret Smith was born in Albury, New South Wales. She married Barry Court in 1967. In 1977, she retired from tennis competition. Arthur Ashe

Court-martial is a military court that tries people who belong to a country's armed forces and are accused of committing certain crimes. In the United States, these crimes are set forth in the Uniform Code of Military Justice. The crimes range from murder, robbery, and drug abuse to offenses specific to the military, such as absence without leave or disrespect to a superior officer. The code provides for three types of courts-martial:(1) general, (2) special, and (3) summary.

A *general court-martial* almost always consists of a military judge and a jury of at least five members of the military. Such a court may try a person for any crime in the Uniform Code. Usually, general courts-martial try only the most serious offenses, such as murder or spying. Punishments may include dishonorable discharge from the military and death.

A *special court-martial* almost always consists of a military judge and a jury of at least three members of the military. It may try any offense in the Uniform Code except those punishable by death. However, special courts-martial may not impose a punishment harsher than a bad-conduct discharge and six months in prison.

A *summary court-martial* consists of only one officer. It can try enlisted people, but not officers. Summary courts-martial usually try only minor offenses, such as short absences without leave. They may sentence the ac-

cused to no more than 30 days in prison and may not impose a discharge from the military.

In general and special courts-martial, defendants receive free counsel from defense attorneys who are also military officers. In addition, a defendant may hire a civilian lawyer. If a defendant is convicted by a general or special court-martial, the commanding officer who referred the case to the court reviews the court's decision. The officer may then approve the conviction and the sentence or make them less severe. A court of military review examines all cases that result in a military discharge or in sentences harsher than a year or more in prison. Certain cases may also be reviewed by the U.S. Court of Military Appeals and the Supreme Court of the United States. Robert C. Mueller

See also **Court of Military Appeals, United States; Uniform Code of Military Justice.**

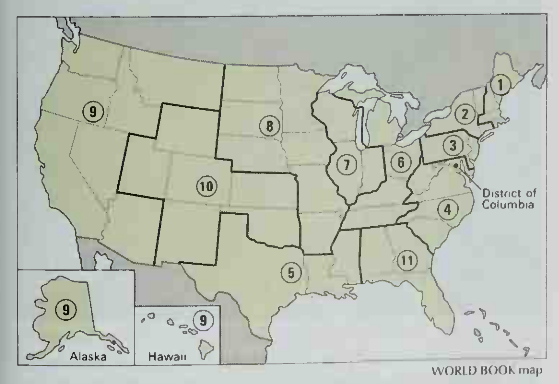
Court of appeals is a high federal or state court. The United States Courts of Appeals rank next to the Supreme Court of the United States as a reviewing authority. Several of the states also have courts of appeals.

The U.S. Courts of Appeals hear most appeals from district courts and federal administrative agencies. They also review the decisions of some agencies. In some cases, the party who feels wronged has a right to appeal directly to the Supreme Court of the United States. In a few cases, the parties have a right to ask the Supreme Court to review a decision of a court of appeals. But in most cases, the Supreme Court only reviews cases that it decides present an important question of law.

In the early days of the United States, federal judges traveled from place to place to try cases and to hear appeals. The route which was assigned to the court was called the *circuit.* Today the circuits are geographical areas. Each circuit has one court of appeals.

The circuits are numbered 1 through 11. A twelfth, unnumbered circuit covers only the District of Columbia. The First Circuit includes Puerto Rico, the Third includes the Virgin Islands, and the Ninth includes Alaska and Hawaii. The judges of the First, Third, and Ninth Circuits travel to these places to hear cases. A special U.S. Court of Appeals for the Federal Circuit has nationwide jurisdiction. It specializes in cases involving patents and claims against the federal government.

Only three judges ordinarily sit to decide each case, though more than three judges are assigned to each circuit. A justice of the Supreme Court is assigned to each circuit as the *Circuit Justice.* In early times, the justice often helped decide cases at the court of appeals level, but now this rarely occurs. The chief judge has a position on the court of appeals like that of the chief justice of the Supreme Court. The chief judge assigns tasks to the other judges. Jack M. Kress



U.S. Courts of Appeals are federal courts that retry cases appealed from district courts. The United States is divided into 12 areas called *circuits,* each of which has a court of appeals.

See also **Appeal; Circuit rider; Court** (Federal courts); **District court; Supreme Court of the United States.**

Court of claims is a special court that settles claims against the government. Many countries have such courts. In the United States, courts of claims exist at the federal and state levels. Judges on the United States Court of Federal Claims travel throughout the country to hear lawsuits brought against the federal government. The president of the United States appoints judges to this court with the approval of the U.S. Senate. The court is based in Washington, D.C.

In 1855, Congress agreed that the United States government could be sued on certain types of matters and created the U.S. Court of Claims to handle such cases. In 1982, Congress changed the court's name to the U.S. Claims Court. In 1992, Congress renamed it the U.S. Court of Federal Claims. The court's judgments may be appealed to the U.S. Court of Appeals for the Federal Circuit. Jack M. Kress

Court of International Trade, United States, is a federal court that handles cases involving imports and other international business. The court hears both civil suits against the United States government and certain civil cases begun by the government. The court is in New York City, but it has nationwide authority and may conduct trials anywhere in the United States. The court was established in 1980 to replace the U.S. Customs Court. It consists of nine judges, who are appointed by the president subject to Senate approval. The president names one of the nine to serve as chief judge.

Critically reviewed by the United States Court of International Trade

Court of Military Appeals, United States, is the highest appeals court of the U.S. armed forces. It consists of five civilian judges appointed by the president. The court automatically reviews court-martial cases in which the defendant is condemned to death. The chief legal officer of the Army, Navy, Air Force, or Coast Guard may ask the court to review court-martial cases. Military personnel may also ask the court to review cases that result in the defendant's imprisonment or discharge from the military. But they may do so only after a court of military review has examined the court-martial findings. About 10 percent of the cases of the Court of Military Appeals are eligible for further review by the Supreme Court of the United States. See also **Court-martial.** Jack M. Kress

Cousin is a person outside your immediate family related to you by blood and descended from the same ancestor. The chart with this article shows how cousins are related.

First cousins are children of brothers and sisters, and so Frank, Julia, and Peter are first cousins. *Second cousins* are children of first cousins, and so Joan, Susan, and Agnes are second cousins, and so on. A *first cousin once removed* is the child of your first cousin, so Susan and Agnes are Frank's first cousins once removed. Helen

	Thomas		
Brothers and sister	John	Robert	Mary
First cousins	Frank	Julia	Peter
Second cousins	Joan	Susan	Agnes
Third cousins	Helen	Stuart	David

and Stuart are Peter's first cousins twice removed, and so on.

See also **Family** (Family relationships).

Cousteau, *koo stoh,* **Jacques-Yves,** *zhahk eev* (1910-1997), was a French oceanographer, author, and motion-picture producer. He developed many techniques for undersea exploration. In 1943, Cousteau helped invent the *aqualung.* This breathing device enables a diver to move about freely under water for long periods. Cousteau also developed the first underwater diving station and an underwater observation vehicle called the *diving saucer.*



Courtesy of Doubleday

Jacques-Yves Cousteau

After 1951, Cousteau explored the oceans with his research ship *Calypso.* He wrote books about sea life that have been translated into many languages. These books include *The Silent World* (1953), *The Living Sea* (1962), and *World Without Sun* (1964). He produced many films about sea life, three of which won Academy Awards.

In 1960, Cousteau and Prince Rainier III of Monaco opposed France's plan to dump radioactive wastes into the Mediterranean Sea. France abandoned the plan that year. During the 1960's and 1970's, Cousteau's television series, "The Undersea World of Jacques Cousteau," dramatized underwater exploration and the need for conservation of ocean life. Cousteau was born in St.-André-de-Cubzac, which is located near Bordeaux.

Carolyn Merchant

Cousy, *KOO zee,* **Bob** (1928-), ranks among the outstanding playmakers in the history of basketball. Cousy played guard for the Boston Celtics of the National Basketball Association (NBA) from the 1950-1951 season through the 1962-1963 season. He helped lead the Celtics to six NBA championships. Cousy won fame for his skillful dribbling and his accurate passing. He led the National Basketball Association in *assists* (passes to teammates that result in baskets) every season from the 1952-1953 season through the 1959-1960 season.

Robert Joseph Cousy was born in New York City. He won All-America honors at College of the Holy Cross in 1950. From 1963 to 1969, he was basketball coach at Boston College. From 1969 to 1973, he coached the Cincinnati Royals in the NBA. Bob Logan

Covenant, Ark of the. See **Ark of the Covenant.**

Covenanters, *KUHV uh nuhn tuhrz,* were members of a series of religious movements in Scotland during the last half of the 1500's and the 1600's. The Covenanters entered into *covenants* (agreements) with one another to defend their Presbyterian Church. They resisted opponents who tried to force them to accept other forms of worship and church government. In 1581, the first important covenant opposed efforts to restore Roman Catholicism to Scotland. When King Charles I tried to impose the Episcopalian prayer book and the English clergy on the Scots, they drew up the National Covenant of 1638 to resist him.

In 1643, the Church of Scotland and the English Parliament signed The Solemn League and Covenant, establishing Presbyterianism in Scotland, England, and Ireland. But the English rulers ignored this agreement and persecuted the Presbyterians. The Covenanters continued to fight for their beliefs until finally, in 1690, King William III permitted the free expression of the Presbyterian faith in Scotland. Peter W. Williams

See also **Scotland** (History).

Coventry, *KUHV uhn tree* (pop. 292,600), is a city in central England. For the location of Coventry, see **England** (political map). Coventry is an important industrial center, and also the site of the Lady Godiva legend and of one of the world's most strikingly modern cathedrals. Products made in Coventry include airplane parts, automobiles, bicycles, textiles, and electrical and engineering goods.

Coventry probably originated as a Saxon settlement in the A.D. 400's. Lady Godiva, who lived in the 1000's, rode naked through Coventry to get her husband—the city's ruler—to reduce heavy taxes (see **Godiva, Lady**). By the late 1300's, Coventry had become a center of textile manufacturing and watchmaking, and of *trade guilds* (organizations that protected and regulated trade).

In 1940, during World War II, German bombers destroyed most of downtown Coventry, including a 600-



Aerofilms, Ltd.

Coventry is the site of two of England's best-known cathedrals. The medieval cathedral at the left was destroyed in 1940, during World War II. A striking modern cathedral was built to its right. The ruins of the original structure have been preserved as a memorial.

year-old Gothic cathedral. The area was rebuilt after the war. The rebuilding project included the construction of the city's famous modern cathedral. The new cathedral, which was completed in 1962, stands next to the ruins of the old one, now kept as a memorial. Peter R. Mounfield

See also **Cathedral** (picture: Cathedral interiors).

Covered wagon. See **Conestoga wagon; Pioneer life in America** (The wagon train); **Westward movement in America** (picture).

Covington, *KUHV ihng tuhn* (pop. 43,370), is a city in northern Kentucky. It lies at the junction of the Ohio and Licking rivers, across the Ohio River from Cincinnati, Ohio. For location, see **Kentucky** (political map).

Covington's products include greeting cards, iron fencing, and packaging materials. An Internal Revenue Service tax-processing office is the largest employer.

The Roman Catholic Cathedral Basilica of the Assumption (formerly St. Mary's Cathedral) is a major landmark of Covington. Begun in 1895, it was modeled after the Cathedral of Notre Dame in Paris. It has one of the world's largest stained-glass windows. Another landmark is the John A. Roebling Suspension Bridge, which connects Covington and Cincinnati. Named after the man who built it, it was opened to traffic in 1866. Roebling and his son later built the Brooklyn Bridge.

Covington was settled in the early 1800's and was incorporated in 1834. The city was named after General Leonard Covington, a hero of the War of 1812. Covington has a commission-manager form of government, and it is one of the two seats of Kenton County.

Robert G. Driehaus

Cow is a female adult animal of the bovine group. The term *cow* is also used for the female of other mammals, including moose and seals. Cows, bulls, and steers are called *cattle* (see **Cattle**).

Cow parsnip is a large, coarse plant which belongs to the parsley family. It grows from 4 to 8 feet (1.2 to 2.4 meters) high and has large, hairy leaves. Its small white flowers grow in huge clusters. The cow parsnip becomes a troublesome weed when allowed to grow in damp soil near water. It may be eaten in place of celery, but it has usually been used as fodder. Albert Liptay

Scientific classification. The cow parsnip belongs to the parsley family, Apiaceae or Umbelliferae. Its scientific name is *Heracleum maximum.*

Coward, Noël (1899-1973), a British playwright, actor, and composer, became famous for his witty, sophisticated comedies. Many of his plays deal with romantic conflicts between upper-class men and women.

Coward's first successful play was *The Vortex* (1924), a serious look at the moral decline of the idle upper class. But such witty romantic comedies as *Hay Fever* (1925), *Private Lives* (1930), *Design for Living* (1933), and *Blithe Spirit* (1941) are more typical. He also wrote *Tonight at 8:30* (1936), a collection of nine one-act plays to be performed in groups of three. Coward composed a number of musicals. The best-known musical is the operetta *Bitter Sweet* (1929).

Coward wrote two autobiographical books, *Present Indicative* (1937) and *Future Indefinite* (1954). *The Noël Coward Diaries* were published in 1982. He also wrote a novel, *Pomp and Circumstance* (1960), and short stories, many published in *The Collected Stories of Noël Coward* (1983). Coward also wrote, codirected, and starred in the film *In Which We Serve* (1942).



Larry Fried, Pix

Noël Coward

Noël Pierce Coward was born in Teddington, near London. His first major success came in 1923 as part author and star of the musical revue *London Calling.* Coward starred in many of his own plays and sang his songs as a cabaret performer. Queen Elizabeth II knighted him in 1970, and he became known as Sir Noël Coward. Gerald M. Berkowitz

Cowbird is the name of a group of birds found in North America and South America. The best-known species is the *brown-headed cowbird,* which lives from southern Canada to Mexico. The male brown-headed cowbird measures about 8 inches (20 centimeters) long. It has a brown head and a shiny black body. The smaller female is brownish-gray in color.

Brown-headed cowbirds lay their eggs in the nests of other birds, leaving the young for the foster parents to raise. The female cowbird chooses a nest that belongs to some smaller birds and lays an egg in it while the owners are away. She then flies off and does not return. The young cowbird is much larger than the other young birds in the nest and usually gets most of the food. As a result, the other nestlings sometimes starve. The foster parents do not seem to realize that they are raising an outsider. But if the egg is discovered, the nest owner may not allow it to hatch. For example, a yellow warbler may cover the egg and build another nest on top of the old one. The eggs of the brown-headed cowbird are white with brown specks.

Several other species of cowbirds live in the Americas. Most of them, like the brown-headed cowbird, lay their eggs in other birds' nests. Cowbirds feed on insects, worms, seeds, and berries. Martha Hatch Balph

Scientific classification. Cowbirds belong to the emberizid family, Emberizidae. The scientific name for the brown-headed cowbird is *Molothrus ater.*



WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

Brown-headed cowbirds range from Canada to Mexico. The female, *right,* is smaller than the male, *left.*



Detail from *Trail Herd to Wyoming* (1923), an oil painting on canvas by W. H. D. Koerner; Buffalo Bill Historical Center, Cody, Wyo.

The trail drive moved large herds of cattle great distances from Western ranches to a railroad station for shipment to Eastern markets. Cowboys rode ahead, behind, and at each side of the plodding herd. A trail drive lasted from two to three months.

Cowboy

Cowboy is a hired hand who herds and cares for cattle and horses that belong to a ranch owner. The cowboy usually does this job on horseback.

In the United States, cowboys won fame in the West during a period that lasted from about 1865 to about 1885. During that time, cowboys tended great herds of cattle on vast stretches of unfenced land called the *open range.* They also took cattle on long *trail drives* to railway stations for shipment to Eastern markets. But by 1890, ranchers of the West needed far fewer cowboys. The use of fences and the spread of farms had put an end to the open range, and expansion of the railroads had eliminated the long trail drives.

The cowboys of the brief open-range period gained a reputation for bravely facing danger and hardships. They became heroes to many Americans. They came to stand for the frontier virtues of courage, independence, and self-reliance. Cowboys found their work difficult, dangerous, and—at times—even dull. But exciting tales of cowboy life became part of American folklore. Many of the most popular novels, motion pictures, and television programs have been about cowboys.

Most cowboys of the American open-range period were young men. Cowboy work was not considered a suitable job for a woman. About the only way a woman could have worked as a paid ranch hand would have been to dress in men's clothing and pretend to be a man. But women often performed the work of a cowboy on family ranches.

The United States has cowboys today, as do other countries with livestock industries. In Argentina and Uruguay, for example, cowboys are called *gauchos (GOW chohs).* This article focuses on the history of the cowboy in the United States. For a description of the life of a modern American cowboy, see **Ranching.**

Richard W. Slatta, the contributor of this article, is Professor of History at North Carolina State University and the author of The Cowboy Encyclopedia.

A cowboy's gear

American cowboys copied much of the equipment, techniques, and language of Mexican cowboys, who were called *vaqueros (vah KAIR ohs).* The big sombrero worn by Mexican cowboys became the American cowboy hat. *La reata (lah ray AH tuh), the rope* in Spanish, became the *lariat* used by cowboys to rope cattle. Even the word *vaquero* became *buckaroo,* another English word for cowboy. The cowboy fashioned much of his clothing and equipment from leather made from cowhide.

His clothing served useful functions. For example, the wide brim of a cowboy hat kept rain, snow, and sun off the cowboy's face. The air space in the hat's deep crown kept the cowboy's head cool. A cowboy could use his hat to fan a fire, to signal to other cowboys, and to scoop up water from a stream.

A coat got in a cowboy's way, so he wore one only in bitterly cold weather. Instead of a coat, most cowboys wore a vest over their shirt. The vest had pockets to hold such items as a watch, tobacco, and a few coins. Most ranch hands carried a yellow oilskin raincoat called a *slicker* tied to the back of their saddle. Some of them put on a long canvas or linen coat called a *duster* as protection against dust and wind.

A cowboy wore seatless leather trousers called *chaps (shaps)* over his regular trousers, which were made of wool, canvas, or denim. Chaps protected his legs from thorny brush and cactuses and from rubbing against the saddle. Chaps were adapted from *chaparajos (shah pah RAH hohs),* the trousers worn by the vaqueros.

Cowboy boots had high, tapered heels to keep a rider's feet from slipping through the stirrups. Their tapered toes prevented a cowboy's foot from catching in a stirrup if he fell from his horse. A cowboy who fell or got thrown might be dragged along the ground if he could not quickly free his foot from the stirrup.

The spurs that cowboys fastened to the heels of their boots helped them control a horse. Each spur had a small spiked wheel at the back called a *rowel.* Rowels varied in size. The cowboy pressed the rowel against the horse's side to guide and control the animal. A cowboy with a few extra dollars might treat himself to a pair of spurs decorated with fancy silver inlays.

A cowboy tied a bandanna, or neckerchief, around his neck. He could pull the bandanna over his nose to filter out dust. Leather gloves protected a cowboy's hands from rope burns. Some cowboys preferred to wear protective leather cuffs instead of gloves.

His horse. Cowboys spent most of their time in the saddle. Horses not only enabled cowboys to cover great distances but also helped them control the cattle. Some cowhands owned their own horse. But on the job, most cowboys rode horses that belonged to the ranch owner. Each cowboy had a string of mounts assigned from the ranch's horse herd. The work was hard on a horse, so a cowboy changed mounts frequently throughout the day.

Cowboys rode horses called *mustangs* or *broncos.* Mustangs were descended from horses that Spanish explorers brought to North America in the 1500's. Some of the Spanish horses escaped, ran loose, and multiplied. By the mid-1800's, bands of mustangs roamed the Great Plains and Rocky Mountains. These small, swift horses made excellent "cow ponies." They had great strength, and they seemed to sense what a cow would do next. Today, the quarter horse has become the cowboy's favorite mount because of its quickness, agility, and "cow sense."

Mustangs had to be tamed before cowboys could ride them. A wild horse would leap, kick, and twist to remove anything on its back. To *break* (tame) a mustang, a cowboy had to get on its back and whip the animal each time it bucked. Most mustangs soon learned that disobedience meant pain and thus began to obey the cowboy. The highly skilled riders who cured mustangs of bucking earned the title—and extra pay—of *broncobusters.* A few horses could never be broken and were called *outlaws.* In time, ranchers bred mustangs with other horses to produce a larger and less wild animal.

His rope. All ranch hands had to become skillful at throwing the rope or lariat, the cowboy's most important tool. One end of the lariat was knotted to form a small eye, called a *honda.* The other end of the rope slipped through the honda to form a large, adjustable loop. A cowboy kept a coiled lariat hanging from his saddle, ready for quick action. In addition to roping a cow, cowboys also used a lariat to pull cattle out of the mud, to tie up horses, and to drag wood to a campfire. As a prank, a cowboy might rope one of his friends or



Through the Alkali (1904), an oil painting on canvas by Charles Marion Russell; The Thomas Gilcrease Institute of American History and Art, Tulsa, Okla.

A cowboy on horseback used equipment and skills borrowed from Mexican cowboys, called *vaqueros.* Cowboys copied the hat, chaps, saddle, lariat, and roping techniques of the vaqueros.

toss a loop at a coyote or even a grizzly bear.

Cowboys adopted the roping techniques of the Mexican vaqueros. To rope a cow, some cowboys wrapped the end of the lariat around their saddle horn. The practice is called *dally roping.* The term comes from the Spanish words *dar la vuelta,* which mean *to take a turn.*

A cowboy whirled the loop of the lariat overhead and then tossed it in front of the cow's onrushing feet or over its head. The cowboy's horse then stopped dead, the loop tightened, and the cow fell to the ground.

His saddle was a cowboy's most prized possession. Every cowboy owned a saddle, even though not all cowboys owned a horse. A saddle had to be well made to hold up under constant use, and a cowboy selected his saddle carefully. After long use, it became well fitted to the cowboy's own body. A cowboy would sell his saddle only when he was totally broke and down on his luck.

Many saddles had a large horn in front, which a cowboy used for dally roping. The high *cantle* (back of the saddle) supported the cowboy's lower back and made all-day rides more comfortable. One or more *cinches* (broad leather straps) around the horse's belly held the saddle firmly in place.

His firearm. Cowboys sometimes carried a revolver with six chambers known as a *six-shooter.* Most of the time, however, a cowboy did not carry a gun. A gun was a nuisance to a man on horseback. It added extra weight and got in the way. Besides, few cowboys had much money to spend on bullets for practice, and a cowboy needed practice to become a good shot. The famous gun duels between cowboys are mostly the creation of novelists and filmmakers.

On a trail drive, a cowboy kept his gun tucked in his

bedroll, which was carried on a wagon. On the range, some ranch hands carried a rifle or *carbine* (short, lightweight rifle) strapped to their saddle. A gun was useful for killing rattlesnakes, shooting a horse with a broken leg, and turning back stampeding cattle. In town, a cowboy might strap on a gun to look impressive when he had his picture taken. But to maintain peace and public safety, town officials often took away a cowboy's gun when he arrived and gave it back to him when he left.

The life of a cowboy

Hard work and danger filled the cowboy's life. The animals he tended often got into trouble. Cowboys had to pull cattle from quicksand and ease them out of barbed wire fences. They had to nurse sick and injured cattle and help cows as they gave birth. When dust storms or snowstorms caused cows to drift away from their range, cowboys had to drive the animals back.

Each day, a cowboy faced the risk of broken bones, crippling accidents, and even death. Because cowboys worked far from towns or medical care, they had to doctor themselves most of the time. Untamed horses often threw riders, and a bad fall could easily break a man's leg. An improperly set bone could leave a cowboy crippled for life. If the cowboy's hand got caught between the rope and the saddle horn when he was dally roping, he could lose his thumb or a finger. A mean horse might race under a low branch to unseat a rider. A kick from a horse could kill. A cowboy could be trampled to death in a stampede.



UPI/Bettmann Archive

Roping cattle was a skill every cowboy needed. A cowboy kept a coiled lariat hanging from his saddle. He knew exactly how to toss the lariat to catch a running animal's legs, head, or horns.

In general, cowboys led a lonely life. Most ranches lay far from even the smallest town. A cowboy could go for weeks without seeing anyone but the few hands he worked with. In cow country, men far outnumbered women, so the odds of finding a wife were poor. Two events broke the monotony of a cowboy's life on the ranch—the roundup and the trail drive.

On the ranch, most cowboys watched over and protected the cattle as they grazed on the range. Cowboys also had to make and repair bridles, harnesses, and other equipment. The cattle the cowboys first tended were *Texas longhorns*. The cattle were named after their long horns, which had an average spread of about 4 feet (1.2 meters). Like mustangs, Texas longhorns were descended from Spanish animals that had gotten loose and multiplied. When early settlers from the East moved to the West, they found longhorn meat to be tough and stringy. They eventually bred longhorns with their Eastern stock to produce more tender meat.

On large ranches, cowboys slept in a bunkhouse apart from the ranch owner's house. A bunkhouse had few comforts. Rows of bunks stood along the walls. Pegs on the wall held clothing and other equipment. After swapping stories or playing a few hands of cards, most cowboys went to bed, exhausted from the day's work.

Before barbed wire fences came into use, cattle roamed freely on the open range. Cowboys called *line riders* worked out of small outposts called *line camps* that stood near the boundaries of a ranch. Each rider pa-



UPI/Bettmann Archive

Branding took place during the roundup. After cowboys had rounded up the cattle, they gave each calf the brand of its mother. Branding served to identify cattle in the days of the open range, when animals could wander great distances over unfenced land.

trolled a certain area, watching for sick or stray cattle and for signs of cattle rustlers.

Barbed wire began to come into use in the West in the mid-1870's. Cowboys then had the added job of building fences. They had to dig the postholes by hand and tightly string the wire with its many sharp points from post to post. Line riders became *fence riders,* who had to spot tears in the barbed wire and mend them. Fences kept the cattle from roaming freely to waterholes, so many ranches added windmills that pumped water into tanks. When the windmills broke down, cowboys had to fix them.

Cowboys worked almost every day, from sunup to sundown. Few cowboys got to town more than once a month, usually on payday. In town, a cowboy might drink and gamble away his pay in a saloon or gambling hall. Sometimes, a cowboy drank too much and got rowdy. He might land in jail for the night and have to pay a fine. But most town marshals were not too hard on cowboys. The merchants did not want to lose their business.

The roundup took place each spring and fall. First, hands had to gather horses that had been grazing on the open range. Broncobusters would tame these mounts for work use. Then cowboys had to gather cattle from the range to identify and brand newborn calves. At the fall roundup, cowboys also selected the cattle to be sold for beef. They rode well-trained *cutting horses* among the cattle to edge out, or cut, an animal from the herd.

On the open range, cattle from several ranches in a region grazed together, so herds became mixed. At roundup time, cowboys from all the ranches worked together to bring in the cattle. Crews of cowboys scattered over the range. They searched for cattle and drove them to a central point. Each rancher had a *rep* (representative), who looked after his interests in the roundup.

After a cowboy cut a calf out of the herd, he drove it to a fire, where branding irons were kept red hot. The cowboy pressed an iron against the calf. The burn that resulted left a permanent scar. Another cowboy counted all the branded calves so owners would know how many cattle remained after those to be marketed had been cut out.

A calf received the brand of its mother. Each ranch had its own brand, placed in a certain position on all its cattle. For example, a brand might be described as a *cloverleaf* placed *right side, flank;* or the letter *R* placed *left side, jaw.* Cattle owners registered their brands with local officials to discourage rustlers.

After branding a calf, cowboys might also make a knife cut in a cow's ear for extra identification. When cattle were bunched together, it was hard to read their brands. But a cowboy could easily see an earmark.

After work each day at roundup time, cowboys from all the ranches got together to sing, tell tall tales, and trade gossip. At the end of most roundups, cowboys competed against one another to determine the best rider, roper, and broncobuster. The competition became known as a *rodeo,* the Spanish word meaning *roundup.*

The trail drive was another major event in a cowboy's life. A trail drive might last two or three months and cover as much as 1,000 miles (1,600 kilometers). During the long drive, cowboys moved from 2,000 to 3,000 cattle to a railroad station for shipment to Eastern markets. They worked long days and sometimes well into the night.

Before the trail drive began, cowboys collected cattle from several ranches and turned them over to a *trail boss* employed by the ranch owners. The trail boss hired 10 to 12 cowboys to handle the herd during the drive. He also hired a *wrangler* and a cook. The wrangler, usually young and inexperienced, looked after the 50 or more horses needed on the drive.

The cook got the *chuck wagon* ready for the trail drive while the cowboys rounded up the herd. This large covered wagon had to carry enough food for the cowboys during the long drive. It also carried cooking utensils, drinking water, and the cowboys' bedrolls.

The tough, hardy longhorns were ideal for trail driving. They ate almost any kind of plant, and their long legs and big hoofs enabled them to travel great distances. Heat and hunger did not seem to affect them. Above all, longhorns could travel as long as three or four days between drinks of water. However, if the cowboys pushed them too long without water, they might stampede at the smell of an upcoming river.

During the trail drive, the cowboys had to keep the cattle together and headed in the right direction. They rode *point* (ahead of the herd), *drag* (behind), and *flank* (at the sides). Cattle sometimes panicked when crossing a river and began swimming in circles. Thunderstorms or any other sudden noise could frighten jittery cattle into stampeding. To stop a stampede, the cowboys would put themselves in danger by racing in front of the herd. They would then wave their hats and fire their guns in the air to turn back the lead cattle.

The drive stopped each day just before sunset at a spot that had been selected by the trail boss. The ideal place was one with good grass and water. After the cattle grazed for a while, the cowboys herded them into a tighter group that was easier to control at night. Cowboys took turns watching the herd through the night. They often sang as they circled the herd because they thought their singing kept the cattle calm.

After the cattle finally settled down for the night, the cowboys ate supper. Their meals on the drive consisted mainly of beans, bacon, and biscuits. A cowboy slept next to a saddled horse so that he could quickly ride if the cattle stampeded during the night.

At the end of the trail drive, the cowboys arrived in a *cow town,* where they loaded the cattle on a train after the herd was sold. A cowboy usually wanted a shave and a haircut first and then a bath and clean clothes. Next, he wanted a good meal. After that, he was ready to celebrate in the nearest saloon. Cowboys received their wages at the end of the drive. Most of them spent their pay in a few days and then headed back to the ranch.

History

The growth of the cattle industry. The United States cattle industry boomed after the American Civil War (1861-1865), creating a huge demand for cowboys. When the war ended, a cow cost from $4 to $5 in Texas, and millions of them roamed the open range, untended for years. At the same time, Easterners wanted beef and were willing to pay from $40 to $50 a head. Texas cattle owners, seeing the big profits to be made, hired cowboys to drive cattle northward to the nearest railroad

station for shipment to the East.

In 1866, cowboys drove thousands of cattle to the railroad station in Sedalia, Missouri, in the first major trail drive. But angry farmers with shotguns along the way persuaded cattle ranchers to find another route for future drives. The farmers objected to having cattle trample their fields. They also feared that "Texas fever," a disease carried by longhorns, would infect their livestock.

In 1867, the Union Pacific Railroad reached Abilene, Kansas, which lay west of farming country. That year, the Chisholm Trail opened. It ran about 1,000 miles (1,600 kilometers) from southern Texas to Abilene. The Western Trail opened in 1876, after farmers settled beyond Abilene. It ended west of Abilene, in Dodge City, Kansas. Abilene and Dodge City became prosperous cow towns.

By about 1870, ranchers had discovered that cattle could survive the cold winters in the northern Great Plains. Ranches quickly sprang up in what are now Montana, Wyoming, Colorado, and the Dakotas, which had few settlers at that time. Cowboys moved north.

The mid-1880's marked the end of the glory days of the cowboy. Cattlemen eager for higher profits overstocked the ranges, and cattle prices plummeted. Extremely harsh winters killed hundreds of thousands of cattle. Ranchers, able to fence off their ranges with barbed wire, hired fewer cowboys. Railroads extended all the way to the West Coast. Thus, in most of the West, the roundup and the long trail drive became a part of history.

The early cowboys. Frontiersmen who had moved to the West learned many of the skills of roping and herding from Mexican cowboys in Texas. There have probably never been more than 100,000 cowboys in the United States at any one time. Historians estimate that probably about a fourth of the early cowboys in the United States were Mexican or Mexican American vaqueros, and another fourth were African Americans. Some Mexican cowboys had remained in Texas after Texas declared its independence from Mexico in 1836, and after Texas became a U.S. state in 1845. Many black cowboys moved to the Western frontier after the Civil War. Others had been slaves on Texas ranches before the war. Hispanic and black cowboys often faced discrimination from white cowhands, ranchers, and others.

Many Westerners looked down on cowboys as rough, rude, and uncivilized. But writers in the East portrayed cowboys as heroes. Popular books and magazines as well as newspapers told of the joys of life on the open prairies of the West. Young men in the East read these fanciful tales and wanted to gallop on horseback and sleep under the stars. Some of them headed west to become cowboys. They quickly learned that life on the range held far more hard work and boredom than romance and excitement. But exciting tales of cowboy life remained a part of American folklore.

Cowhands today continue to work on ranches and tend cattle, but their numbers have greatly decreased from the golden age of the late 1800's. They still work hard for low pay. They still must know how to rope and ride and must work long hours in any kind of weather. But they often use machines for many jobs, such as digging holes for fence posts. Propane gas, not wood, often heats branding irons. Modern cowboys travel in pickup trucks, transport cattle by trucks, and use helicopters to search for stray cattle. Richard W. Slatta

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Texas (picture)
Western frontier life in America
Westerns
Westward movement in America

Outline

I. **A cowboy's gear**
   A. His clothing
   B. His horse
   C. His rope
   D. His saddle
   E. His firearm
II. **The life of a cowboy**
   A. On the ranch
   B. The roundup
   C. The trail drive
III. **History**

Questions

Why were Texas longhorns ideal for trail drives?
What was a line rider's job?
When did the cattle industry become important in Texas?
What is a rowel? A honda?
Where did the Chisholm Trail run?
What made the cowboy's life a lonely one?
When did roundups take place?
Why did a cowboy rarely carry a gun?
What put an end to the open range?
What did it mean when a cowboy had to sell his saddle?

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Cowell, *KOW uhl,* **Henry** (1897-1965), was an American composer. His works and theories greatly influenced the development of experimental music in the United States. Cowell developed the technique of *tone clusters.* He created these dissonant effects by having a pianist strike groups of adjacent keys with the fingers, fist, or forearm. Such European composers as Béla Bartók used tone clusters in their works.

Cowell composed an enormous amount of music, including 19 symphonies. Perhaps his greatest symphony is Symphony No. 11 *(Seven Rituals of Music,* 1953). Cowell based several compositions on the music of India, Japan, and other Asian nations. Such works as *Tales of the Countryside* (1941) show the influence of his lifelong interest in folk music. Cowell followed the form of earlier American hymns in a series of 18 pieces for various combinations of instruments, which he called *Hymn and Fuguing Tune* (1944-1964).

Cowell discussed his theories in the book *New Musical Resources* (1930). He and his wife, Sydney, wrote *Charles Ives and His Music* (1955). This book helped establish Ives's reputation as a major American composer. Cowell was born in Menlo Park, California, on March 11, 1897. Richard Jackson

Cowley, Abraham (1618-1667), was an English poet and essayist whose first volume of verse was published when he was 15. His major publications include *Poetical Blossoms* (1633), *The Mistress* (1647), and his unfinished epic, *Davideis* (1656). Cowley began as a rather derivative, mechanical love poet, strongly influenced by poet

John Donne and his followers. Later, Cowley began to write *Odes* in the manner of the Greek poet Pindar. This new style produced his best poem, "Ode to the Royal Society." Samuel Johnson published a famous attack on the metaphysical poets in his *Life of Cowley* (1779).

Cowley was born in London. As a follower of Charles II, he served the royalist cause in exile during the Puritan revolution. He returned to favor after the Restoration in 1660. That year, Cowley helped form the Royal Society, an organization that promotes the natural sciences, and became one of its first members. Gary A. Stringer

See also Metaphysical poets.

Cowpea is a trailing or bushy vine widely cultivated in warm regions. One kind of cowpea, known as the *black-eyed* pea, grows wild in Africa but is cultivated in the United States. Another kind more common in tropical regions is called the *asparagus bean* or *yard-long bean.* The flowers of cowpeas are yellowish-white to purple, and they usually grow in pairs. In the Southern United States, cowpeas may be grown as food for livestock. Some kinds of cowpeas are eaten in the pod, shelled, or used in soups and stews.

Scientific classification. The cowpea belongs to the pea family, Fabaceae or Leguminosae. Its scientific name is *Vigna unguiculata.* Daniel F. Austin

Cowper, *KOO puhr* or *KOW puhr,* **William** (1731-1800), was an English poet. He wrote simple poems about nature and rural domestic life. These poems became forerunners of the works of the English romantic poets of the early 1800's. They anticipated the romantics in their themes and in shunning the stilted language of many poets of Cowper's time. He also was one of the great English letter writers.

Cowper was born in Great Berkhampstead, Hertfordshire. A shy, gentle man, he suffered frequent attacks of spiritual despair. In 1765, Cowper went to live in Huntington with the family of Morley Unwin, a clergyman. Beginning in 1767, after Unwin's death, he lived in the country under the tender care of Mrs. Mary Unwin and her children and John Newton, a minister.

During his healthy periods, Cowper wrote many great hymns. The *Olney Hymns* (1779), written with Newton, includes the famous "Oh! for a Closer Walk with God" and "God Moves in a Mysterious Way."

Much of the charm of Cowper's poetry comes from his gracious, kindly personality. Cowper also had a good sense of humor. His comic masterpiece is the merry ballad "The Diverting History of John Gilpin" (1782). Cowper was angered by the inhumanity shown in people's dealings with one another. "Minds are never to be sold!" he declared in his antislavery poem, "The Negro's Complaint." But Cowper typically wrote quiet, descriptive, thoughtful poems about nature and daily life. He liked tame, not wild nature. "Yardley Oak" (1791) does not describe the oak but the nostalgic feelings it arouses in the poet. This focus on the poet's emotional response to nature became a major theme in lyrics of the romantic poets. His last poem, "The Castaway" (1799), powerfully evokes feelings of gloom and despair.

Cowper's major work was a 5,000-line poem called *The Task* (1785). This long, rambling poem was written in blank verse. It describes familiar rural sights and events and shows Cowper's love of the country and his distaste for city life. Frederick W. Shilstone

Cowrie, *KOW ree,* also spelled *cowry,* is a sea snail with a shiny, often colorful shell. It lives in shallow waters of warm seas. Cowries grow from about $\frac{1}{2}$ to 7 inches (1.3 to 18 centimeters) long. The shell is normally covered with a colorful skinlike extension called a *mantle.* The mantle often has tentacles or fringes. The underside of the shell has a long, narrow opening bordered by shell teeth. Cowries usually feed at night on *algae* (plantlike organisms), sponges, and other creatures. There are about 200 kinds of cowries. People often use cowrie shells to make jewelry. Some rare cowries are valuable to shell collectors. See Shell (pictures).



Zig Leszczynski, Animals Animals

A cowrie has a glossy, richly colored shell. Some types of rare cowries are highly prized by shell collectors.

Scientific classification. Cowries belong to the cowrie family, Cypraeidae. Robert S. Prezant

Cowslip is the name of four flowering plants. These plants are the *marsh marigold,* the *Virginia cowslip,* the *shooting star,* and the *European cowslip.*

The marsh marigold grows in swampy places. Its bright yellow flowers appear from April to June. People often eat the leaves and stems of this plant. The Virginia cowslip is also called the *Virginia bluebell.* Its bell-shaped flower clusters always seem to be nodding. The shooting star is the common name for a group of plants also known as *American cowslips.* The flowers of these plants have a distinctive shape. The petals of the American cowslip bend backward, and the pistil and yellow stamens form a pointed tip that seems to shoot out of the flower. The European cowslip grows in meadows throughout Europe. It has fragrant clusters of large yellow or purple flowers.

Scientific classification. The marsh marigold belongs to the crowfoot family, Ranunculaceae. It is *Caltha palustris.* The Virginia cowslip belongs to the borage family, Boraginaceae. It is *Mertensia virginica.* The shooting star and the European cowslip belong to the primrose family, Primulaceae. Shooting stars make up the genus *Dodecatheon.* The European cowslip is classified as *Primula veris.* Melinda F. Denton

See also Primrose.

Cox, James Middleton (1870-1957), an American politician and newspaper publisher, was the Democratic candidate for President in 1920. He and his running mate, Franklin D. Roosevelt, were defeated by a Republi-

can landslide that elected Warren G. Harding President and Calvin Coolidge Vice President.

Cox began his political career by serving in the U.S. House of Representatives from 1909 to 1913. He was elected governor of Ohio in 1912, 1916, and 1918. Cox owned newspapers and radio and television stations in Ohio, Georgia, and Florida. In 1933 he served as a delegate to the World Monetary and Economic Conference in London. He wrote an autobiography, *Journey Through My Years* (1946).

Cox was born in a log-cabin farmhouse near Jacksonburg, Ohio. He later became a teacher. Cox bought his first newspaper at the age of 28. James S. Olson

Coxey, *KAHK see,* **Jacob Sechler** (1854-1951), organized *Coxey's Army,* a group of unemployed men, during the depression of the 1890's. He organized the "army" to attract national attention to his plan that the government create jobs through a road-improvement program. Coxey marched out of Massillon, Ohio, with 100 men and his infant son, Legal Tender Coxey. Coxey's Army paraded in Washington, D.C., on May 1, 1894, with nearly 500 men. The demonstration collapsed when Coxey was arrested for walking on the Capitol lawn. In 1932, he was the Farmer-Labor Party candidate for President of the United States. Coxey was born in Selinsgrove, Pa.

Edward A. Lukes-Lukaszewski

See also **Cleveland, Grover** (picture: "Coxey's Army").

Coyote, *KY oht* or *ky OH tee,* is a wild member of the dog family. It is known for its eerie howl, usually heard during the evening, night, or early morning.

Coyotes once lived primarily in western North America. However, they now inhabit much of the United States, Canada, and Mexico, and even parts of Central America. The coyote lives in a variety of environments, including deserts, mountains, and prairies. It is sometimes called the *prairie wolf* or *brush wolf.*

Adult coyotes vary in color from light yellow or yellowish-gray to brownish-yellow. Their fur may be tipped with black. The coyote has large, pointed ears and a bushy tail. An adult coyote measures about 4 feet (1.2 meters) long, including its 11- to 16-inch (28- to 41-centimeter) tail. It stands about 2 feet (0.6 meter) high and weighs from 25 to 30 pounds (11 to 14 kilograms). Most coyotes live alone or in pairs, but some form groups of three or more.

Most female coyotes first mate when they are about 2 years old. They have a pregnancy period of 60 to 63 days. In spring, the female usually gives birth to five or six pups. A newborn coyote weighs from 7 to 10 ounces (200 to 275 grams). It is born blind, but its eyes open within two weeks. The mother provides milk for her young until they are 6 or 7 weeks old. By that time, the pups have begun to eat prey and other foods supplied by their parents. Most coyote pups can care for themselves by late summer, when they leave the parents.

Coyotes feed chiefly on rabbits and on rodents, such as gophers, mice, prairie dogs, rats, and squirrels. Coyotes also prey on antelope, goats, sheep, and other animals. The coyote eats various insects and reptiles as well. During the winter, many coyotes in northern regions feed on the remains of large dead animals, such as cattle, deer, and elk. In some areas, coyotes eat juniper berries, mesquite beans, watermelons, and other fruits for a few weeks of the year.



The coyote lives in most areas of the United States, Canada, and Mexico and in some parts of Central America. Unlike most animals, the coyote has expanded its range through the years.

Some ranchers dislike coyotes because the animals kill cattle, sheep, and other livestock. Other people, however, think coyotes help keep rodent populations under control and are valuable for that reason. Some people hunt and trap coyotes for sport. Coyote pelts are used to make coats and to trim parkas or other clothing.

Scientific classification. The coyote belongs to the dog and wolf family, Canidae. Its scientific name is *Canis latrans.*

Frederick F. Knowlton

Coypu. See Nutria.

Coysevox, *kwaz VAWKS,* **Antoine,** *ahn TWAHN* (1640-1720), was the leading French sculptor during the latter part of the reign of Louis XIV. Coysevox produced much of the sculpture that decorated the gardens and Palace of Versailles. Much of his work reflected the tastes of Louis XIV. Its rich, ornamental style reflects a desire for dignity and grandeur.

Coysevox also made many portrait busts. Several of those he did later in his career are more informal and lively than his earlier decorative sculpture. This informality reflected the developing taste of the 1700's. Coysevox was born in Lyon. A picture of his statue *Mercury* is in the **Sculpture** article. Douglas K. S. Hyland

Cozzens, *KUHZ uhnz,* **James Gould,** *goold* (1903-1978), an American author, became best known for his novels of upper-class manners. Cozzens' fiction shows his fascination with social roles and forms. His typical hero is a professional man who distrusts emotion and believes in reason and self-discipline. Cozzens' style is analytical and filled with realistic detail.

Cozzens won the 1949 Pulitzer Prize for fiction for his novel *Guard of Honor* (1948), which concerns military life on an Air Force base. Cozzens' most popular novel is *By Love Possessed* (1957). The work investigates how a lawyer's life and principles are shaken by discoveries he makes about his friends and family. *Men and Brethren* (1936) is a study of a liberal clergyman. *The Just and the Unjust* (1942) describes the impact of a murder trial on the various participants.

Cozzens was born in Chicago. He wrote his first novel in 1924, but his first notable work was the novelette *S.S. San Pedro* (1931). Samuel Chase Coale

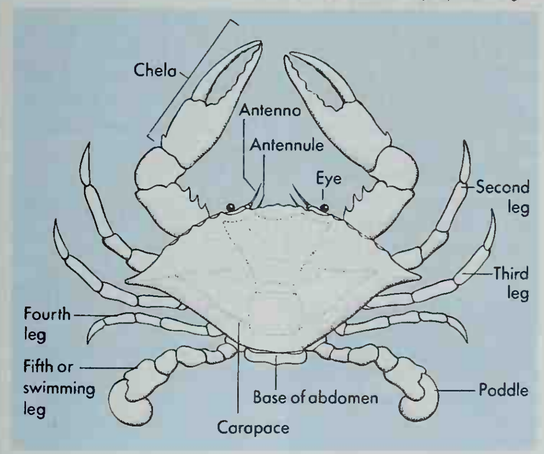
CPA. See **Accounting; Certified public accountant.**
CPR. See **Cardiopulmonary resuscitation.**
Crab is a type of animal with a hard shell and jointed legs. Some crabs live in shallow waters along seashores, and some are found in deeper waters. Others live in burrows on sandy beaches or muddy shores. Only a few species of crabs live in fresh water or on land. Certain species of crabs are popular seafood.

Crabs belong to a group of invertebrate animals called *crustaceans.* A crab's abdomen, unlike that of other crustaceans, lies folded under the body. The male crab has a narrow abdomen, but the female's abdomen occupies the entire space between the legs. A crab's shell, called the *carapace,* covers the upper side of the body.

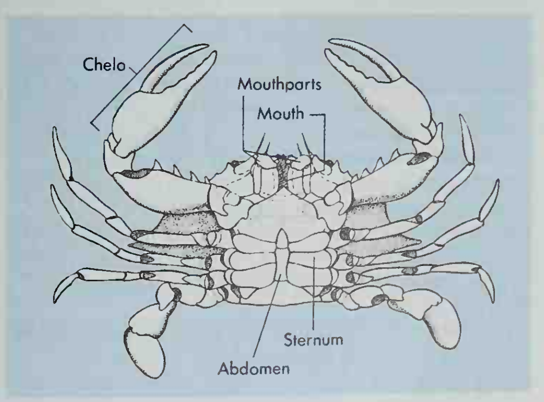
A crab has five pairs of legs. The first pair bear large claws called *chelae.* The shape and size of the chelae vary greatly among species and even in the same individual. In male *fiddler crabs,* for example, one chela is much larger than the other. The male waves this large chela about to attract female crabs and to threaten smaller male crabs (see **Fiddler crab**). Most crabs prowl sandy or muddy shores by walking or running sideways on the tips of their last four pairs of legs. In crabs that swim, the last pair of legs are modified into paddles.

Top view of a blue crab

WORLD BOOK illustrations by Lloyd P. Birmingham



Underside view of a blue crab



Some kinds of crabs





Crabs make up part of the animal life along many seashores. The ghost crab, *left,* lives in burrows on sandy beaches. Its color blends so well with sand that a motionless ghost crab seems to disappear. The rock crab, *right,* dwells on rocky seashores.





WORLD BOOK illustrations by James Teason

Several crabs live in unusual places. The female pea crab, *left,* lives in the shell of a live oyster. The pine crab, *right,* makes its home in bromeliad plants that grow on tropical trees. It lives in water that collects at the bottom of the plant.

Crabs feed on many kinds of water organisms or the remains of organisms. Some species of crabs eat chiefly algae and plants. Almost all species of crabs *spawn,* (lay eggs) in salt water. A newly hatched crab cannot survive in fresh water.

The *coral gall crab* is the smallest crab known. It measures about $\frac{1}{10}$ inch (2.5 millimeters) long and $\frac{1}{12}$ inch (2.1 millimeters) wide. The coral gall crab lives in cagelike formations of coral in the Caroline Islands of the Pacific Ocean just north of the equator. The *giant spider crab* of Japan is the largest crab. The giant spider crab measures as much as 12 feet (3.7 meters) long between outstretched claws.

The *blue crab* is the most common crab sold as food in eastern North America. It is caught with nets or hooks. After blue crabs *molt* (shed their shell) and before the new shell hardens, they are sold as *soft-shelled crabs.*

Two types of edible crabs are found along the Pacific coast of North America. The huge *red king crab* lives in deep waters from the Gulf of Alaska to the Bering Sea. It weighs about 12 pounds (5.5 kilograms). The *Dungeness crab* is found in shallow waters from California to Alaska. Fishing crews catch both these species with nets or traps.

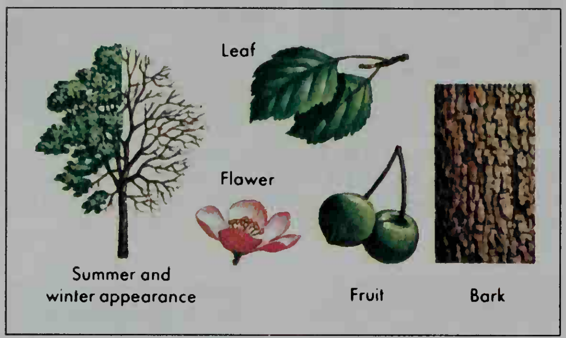
Scientific classification. Crabs are in the subphylum Crustacea of the phylum Arthropoda. They belong to the order Decapoda.

Jonathan Green

Related articles in *World Book* include:

Animal (picture: Coconut crab)
Arthropod
Blue crab
Crustacean
Fiddler crab
Hermit crab

Crab apple is any of a wide variety of small trees that bear apples less than 2 inches (5 centimeters) in diameter. About 25 species of crab apple trees grow wild in the Northern Hemisphere. Most of them originated in



WORLD BOOK illustration by John D. Dawson

The crab apple tree has large white to deep pink flowers. Its fruit can be eaten fresh or used in jellies, butter, and pickles.

Asia. About 7 species are native to North America. In addition, hundreds of *cultivars* (cultivated varieties) of crab apple trees have been produced. Most of these cultivars are grown for use as landscape trees, especially in urban areas. Some are raised for their edible fruits, which are mostly used for making jellies.

Most crab apple trees measure less than 30 feet (9 meters) high. The trees produce white to deep pink flowers in the spring. Some bear red or yellow fruits that remain colorful through autumn and early winter. Some crab apple cultivars are particularly resistant to diseases and insects. Such cultivars have made the crab apple the chief flowering landscape tree in most parts of the United States.

Scientific classification. Crab apple trees belong to the rose family, Rosaceae. They are genus *Malus*. Harrison L. Flint

Crack. See Cocaine.

Cradles of civilization. See Asia (History).

Craft. See Handicraft.

Cramp is a painful, uncontrolled contraction of one or more muscles. Cramps may involve any muscular area of the body. There may be only a single *spasm* (contraction) of the muscle, but usually it is followed by more intense cramping that begins and ends quickly and abruptly. A severe muscle spasm may continue for several hours or even days if untreated.

Cramps can occur either in skeletal muscles or in smooth muscles. When work is unusually hard and repetitious over long periods, the involved skeletal muscles often will cramp. Also, cramping is more likely to develop when one works or performs physical activity in the heat. This condition is called *heat cramp* and is associated with heavy sweating and loss of salt from the body. For example, foundry workers and fire fighters do heavy work in the heat and may develop cramps in their arms and legs.

Athletes often develop cramps in the muscles they use most strenuously. For example, runners may develop cramps in their legs. Cramps also can develop when certain muscles are used too much in performing ordinary, daily tasks. For instance, a person who writes for a long time may develop writer's cramp.

Perhaps the best-known cramps are those of the smooth muscles of the stomach and intestines. These may result from poor eating habits or from chilling the stomach. They often cause common stomachaches. Cramps are also characteristic of many diseases.

Doctors treat cramps with heat and massage, and give medicines to relieve pain. They may also administer drugs that relax the muscles. Paul A. Molé

Cranach, *KRAH nahk,* **Lucas, the Elder** (1472-1553), was one of the leading German painters of the Renaissance. In his duties as court painter at Wittenberg, Cranach painted many of the great people of his time. He painted portraits of the Protestant leader Martin Luther and Luther's family, but also filled many commissions for religious paintings for Roman Catholic patrons. In addition, Cranach became known for his humorous versions of Greek mythology.

Like other German artists of his time, Cranach was active in printmaking. He invented the *chiaroscuro* woodcut, which uses two woodblocks to create a picture, one for lines and one for areas of color.

Cranach was born in Kronach, Bavaria. He took his name from the town and his real name is unknown. His three sons were minor artists. Ann Friedman

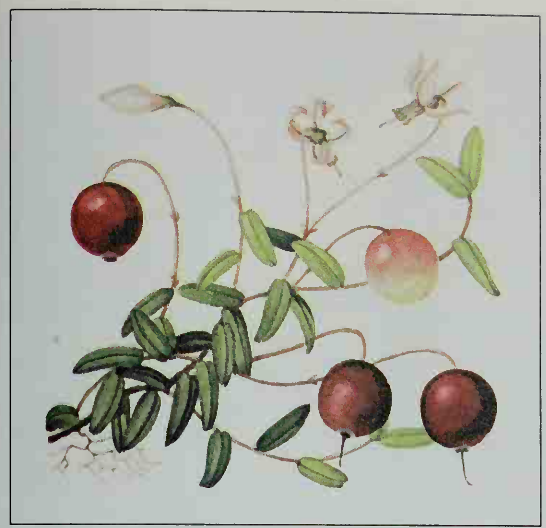
Cranberry is a red, tart, round or oval fruit that grows on an evergreen vine. In the United States, cranberry sauce is a traditional Thanksgiving food. Many people also drink cranberry juices. Cranberries contain vitamin C. In the 1800's, many American sailors on long voyages ate cranberries to prevent *scurvy,* a disease caused by a lack of vitamin C. Some North American Indians have traditionally used the berries as a medicine and as a dye.

The cranberry vine grows low to the ground and produces white or pink flowers. It has oblong leaves and woody trailing stems called *runners.* The berries develop on *uprights,* stems that rise from the runners. Cranberry vines are native to North America. They grow wild in swampy areas of cool regions. In the United States, commercial growers cultivate cranberries in Massachusetts, New Jersey, Oregon, Washington, and Wisconsin. Cranberry production in Canada takes place in British Columbia, Quebec, and Nova Scotia.

Commercial growers prepare special *bogs* (swampy areas) for cranberries. The growers clear and level the land for quick flooding and drainage. They then cover the soil with 3 to 4 inches (8 to 10 centimeters) of sand. Cranberries grow best in acidic soil that contains some *organic matter* (material produced by plants and animals). The bogs must have a large supply of water nearby. Growers flood the bogs repeatedly to protect the plants from frost, insects, and disease and also when the berries are ready to harvest. If correctly prepared, a bog can produce fruit for more than 60 years.

Growers start new cranberry vines from cuttings 6 to 8 inches (15 to 20 centimeters) long. The cuttings are spread over the sand, then pressed into the sand by machine. Growers sometimes plant the cuttings by hand, placing the vines about 1 foot (30 centimeters) apart. As the cuttings grow, they form a matlike covering over the floor of the bog. The vines begin producing fruit after about three years.

Cranberries are harvested in September and October. To harvest berries for processing into juice or sauce, workers flood the bog. A harvesting machine then rakes



WORLD BOOK illustration by Kate Lloyd-Jones, Linden Artists Ltd.

Cranberries grow on evergreen vines in cool regions of North America. The berries have a tart taste and are used in cranberry sauce and other foods.

or knocks the berries from the vines. The berries float to the surface of the water, where workers collect them. To gather berries to be sold whole, mechanical rakes or scoops pick the berries off the vines. This method better preserves the firmness of the berries. Max E. Austin

Scientific classification. Cranberries belong to the heath family, Ericaceae. The scientific name for the American cranberry is *Vaccinium macrocarpon.*

See also New Jersey (picture: Workers harvest cranberries).

Crandall, Prudence (1803-1890), was an American teacher who played an important role in the abolitionist movement. She won much support from abolitionists when she opened a Connecticut boarding school for black girls despite community opposition.

In 1831, Crandall established the Canterbury Female Boarding School for white girls in Canterbury, Connecticut. Two years later, she admitted a black girl for the first time. The parents of the other students threatened to withdraw their daughters from the school, and Crandall closed it in February 1833.



Department of Manuscripts and Archives, Cornell University, Ithaca, N.Y.

Prudence Crandall

Crandall reopened the school in April 1833 with 20 black girls as students. Many citizens of Canterbury objected and tried to discourage Crandall and her students. Later in 1833, Crandall was arrested and charged with breaking a new state law that prohibited the education of blacks who did not come from Connecticut. Leading abolitionists contributed money for her defense in court. She was convicted, but a higher court reversed the decision in 1834. A local mob then attacked the school, and Crandall closed it for the final time. She was born on Sept. 3, 1803, in Hopkinton, Rhode Island. Nancy Woloch

Crane is the name of a family of large birds with long legs and a long neck. Cranes live in marshy areas in many parts of the world. South America and Antarctica are the only continents with no cranes. Cranes resemble herons, but the two birds can be distinguished in flight. Cranes extend their head and neck straight ahead when they fly, but herons bend theirs into an S-shape.

Appearance. Cranes have long and slender legs, necks, and bills. The tallest cranes stand about 5 feet (1.5 meters) high, and the shortest are about 2 $\frac{1}{2}$ feet (0.8 meter) tall. A crane's wingspan can measure up to 7 $\frac{1}{2}$ feet (2.3 meters). The male and female look alike. They range in color from white to dark gray and brown. Most adult cranes have a patch of red skin on the head.

Habits. Most cranes that live in the Northern Hemisphere migrate south each fall from nesting grounds in the north. They return to their nesting ground each spring. Other cranes remain the year around in warm areas. A crane's powerful, buglelike voice carries for a great distance. The birds call to each other in flight, perhaps to keep the flock together during migration.

Cranes mate after they reach their nesting grounds. The male and female perform a dance before mating. The birds alternately circle around each other with opened wings, bow their heads, and leap into the air.

Cranes build nests in shallow water in a marsh, swamp, or other wet, open area. Both the male and the female help pile grasses, weeds, and other plants into a mound. A female crane usually lays only two eggs in a season. Both parents care for the eggs and young.

Cranes eat a variety of foods, including frogs, insects, snails, and grain and other plants. They are a pest in some areas because they take grain from farmers' fields.

Kinds. There are 15 species of cranes. Only two species are native to North America—the rare *whooping crane* and the more common *sandhill crane.*

Whooping cranes, or *whoopers,* once nested on the prairies of the United States and Canada. They began to die out during the 1800's, when settlers disturbed their nesting grounds. By 1954, only one flock of 21 birds remained. Laws now protect whoopers and their habitat. Scientists are breeding whoopers in captivity and are working to establish more flocks in the wild. Today, a few hundred whooping cranes are alive. But they remain one of the rarest birds in North America. See **Whooping crane**.

Sandhill cranes nest in northern Russia, Canada, and the northern United States, as well as in Florida, Georgia, Mississippi, and Cuba. Only the sandhill cranes that nest in the north migrate. They winter mostly in Texas, New Mexico, and Mexico. Migrating sandhill cranes travel in enormous flocks, which may include more than 100,000 birds.

More species of cranes live in Africa, Asia, and Europe than in North America. Africa's elegant *crowned cranes* have an ornamental tuft that resembles a shaving brush on top of their head. Southern Asia's *sarus cranes* are prized by Hindus, who believe that seeing a pair of these birds brings good luck. The *common crane* is a familiar bird in the northern parts of Asia and Europe.

Several species of cranes have become rare because



The whooping crane, *right,* is the tallest bird of North America. The bird has a wingspread of 6 to 8 feet (1.8 to 2.4 meters). It stands 4 to 5 feet (1.2 to 1.5 meters) tall. The largest flock of whooping cranes nests in northern Canada and spends the winter in Texas.

WORLD BOOK illustrations by Walter Linsenmaier

Fred W. Lahrman, Saskatchewan Museum of Natural History

Sarus crane
Grus antigone
Found in southern Asia from India to the Philippines
Body length: 60 inches (152 centimeters)

Demoiselle crane
Anthropoides virgo
Found in south-central Eurasia
Body length: 38 inches (97 centimeters)

Sandhill crane
Grus canadensis
Found in northern and southeastern North America and northern Russia
Body length: 44 inches (112 centimeters)

marshes in many areas have been drained for farming and for settlements. Destruction of their breeding ground is the chief threat to these cranes' survival.

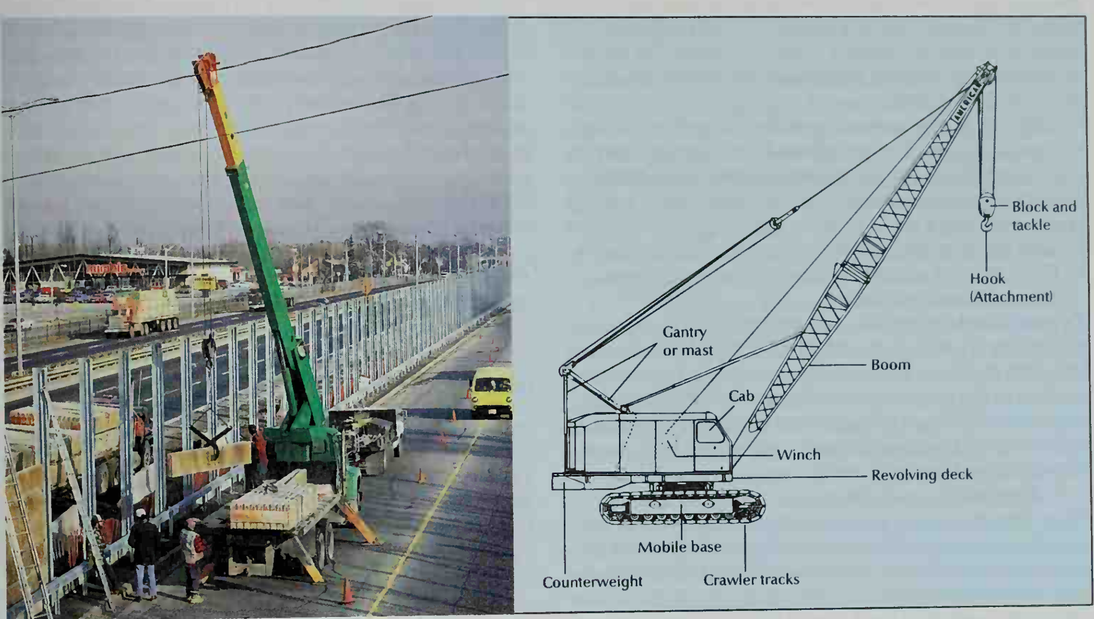
James J. Dinsmore

Scientific classification. Cranes make up the crane family, Gruidae. The scientific name for the whooping crane is *Grus americana.* The sandhill crane is *G. canadensis;* the sarus crane, *G. antigone;* and the common crane, *G. grus.* The black crowned-crane is *Balearica pavonina.*

See also **Bird** (Bird refuges; Endangered species).

Crane is a machine that lifts, transports, and sets down heavy objects. Cranes are used in such workplaces as factories, shipyards, and construction sites. A crane picks up a load using an *attachment,* such as a hook, bucket, or platform. On most cranes, the attachment is connected to a *block and tackle,* a system of pulleys and a cable. The end of the cable winds around a *winch* (rotating drum). Turning the winch raises or lowers the load.

There are many types of cranes, each of which has its own use. *Crawler mounted cranes* and *wheel mounted cranes* are used on construction sites to lift heavy objects and to move materials and equipment. Both types use a *boom* (long arm) and a block and tackle to raise and lower the load. A crawler mounted crane moves on continuous tracks. It moves equally well over hard, soft, and uneven surfaces. Heavy weights called *counterweights* on the back of the crane help prevent tipping and increase the amount of weight the crane can lift. Wheel mounted cranes include those attached to trucks



David Tarrant, Shostal



© David R. Frazier



Cranes grasp the load with an *attachment,* such as a hook. A *block and tackle,* a system of pulleys and a cable, lifts the load. A long arm called a *boom* moves the load about. Various devices prevent the weight of the load from tipping the crane. The *truck crane,* a mobile crane mounted on a truck, *upper left,* uses legs that extend from the base. The *crawler crane,* a mobile crane on a crawler base, *above,* uses a counterweight. A *tower crane, left,* is set atop a tall *mast.* Its load is balanced by a counterweight on the other end of a long horizontal section called a *jib.*

or special wheeled vehicles. They can get from one place to another quickly. They move well only on flat, hard surfaces. They use *outriggers,* long arms that extend from the crane to the ground, to prevent tipping.

A *tower crane* is typically fixed in place. It is shaped like a "T." The vertical section is made up of segments that form a steel framework or support tower called a *mast.* An arm called a *jib* forms the horizontal section. One side of the jib holds the load, and the other holds a counterweight. Tower cranes are often built temporarily in the elevator shafts of tall buildings under construction. They extend above the top of the building and move heavy objects, tools, and materials from the ground to the construction area. As the building grows, some tower cranes add sections to the mast to increase their height. Others use a telescoping mechanism. Some tower cranes are fixed to the ground and use cables called *guy lines* for support. Others are mounted on railroad tracks so they can move. Such cranes are used at docks to unload freighters.

Different attachments allow cranes to perform different types of work. Cranes with hook attachments can lift objects. Magnet attachments are used to move scrap metal. Bucket attachments allow cranes to move wet concrete. Using a shovel attachment, a crane can dig in an area not accessible to other digging machines, such as the bottom of a body of water. Matthew A. Dettman

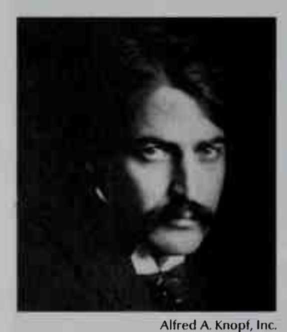
See also **Block and tackle.**

Crane, Hart (1899-1932), was an American poet best known for his complex work *The Bridge* (1930). Crane used the Brooklyn Bridge in New York City as his major symbol of the meaning and texture of modern life in the United States. Crane incorporated history, geography, and technology into an abstract, mythological vision of America's past, present, and future.

In *The Bridge,* Crane interwove legendary figures from American history with modern inventions. For example, he portrayed Rip Van Winkle as a passenger on a New York City subway. The subway itself is a vehicle that carries the reader backward into America's past and forward into a vision of the future. Although Crane was optimistic about life in the United States, his poem shows his awareness of the problems created by an industrial society. Crane published one other book of poems during his lifetime, *White Buildings* (1926).

Harold Hart Crane was born in Garrettsville, Ohio, on July 21, 1899. He had an unhappy personal life and committed suicide at the age of 32. Bonnie Costello

Crane, Stephen (1871-1900), was an American novelist, short-story writer, poet, and journalist. Although he died of tuberculosis at the age of 28, Crane produced a vast number of newspaper articles, over 100 stories and sketches, two volumes of poetry, and six novels. He pioneered in psychological realism, often exploring thoughts of fictional characters facing death.


Alfred A. Knopf, Inc.
Stephen Crane

Crane's greatest novel is *The Red Badge of Courage* (1895), a story set during the American Civil War (1861-1865). It portrays a young Union soldier who undergoes a transformation from cowardice to heroism amid the noisy confusion and "crimson roar" of the battlefield. Crane based the youth's experiences on conversations with veterans of combat, fictional works, histories of military campaigns, and his vivid imagination. The novel remains a masterpiece of literature about war.

Crane was born in Newark, New Jersey, on Nov. 1, 1871. In 1891, he moved to New York City to work as a free-lance newspaper writer. His observations of slum life inspired his first novel, *Maggie: A Girl of the Streets* (1893), about a young prostitute driven to suicide. Its subject matter discouraged publishers from accepting the manuscript, so Crane published it at his own cost.

Following a trip to the Great Plains and the South in 1895, Crane wrote two of his finest short stories. "The Bride Comes to Yellow Sky" (1898) is an unconventional Western showdown between a gunman and a Texas marshal. "The Blue Hotel" (1898) is an ironic account of an immigrant's death in Nebraska. After 1896, Crane traveled widely, covering two wars and accepting newspaper assignments. On Jan. 2, 1897, he was shipwrecked off the coast of Florida. The experience provided material for his classic story "The Open Boat" (1897).

Crane's poetry was collected in *The Black Riders and Other Lines* (1895) and *War Is Kind* (1899). His cynical poems anticipate the free verse style of the 1900's.

Alan Gribben

Additional resources

Davis, Linda H. *Badge of Courage: The Life of Stephen Crane.* Houghton, 1998.
Wertheim, Stanley, and Sorrentino, P. M. *The Crane Log: A Documentary Life of Stephen Crane.* G. K. Hall, 1993.

Crane, Walter (1845-1915), was an English artist who became famous for his illustrations for children's books. Crane's illustrations are noted for their flat colors and attention to details of clothing and objects. The bold, simple compositions reflect his interest in Japanese prints.

Crane was best known for his pictures for over 30 *toy books,* which were small volumes of nursery rhymes and fairy tales for young children. His toy books include *Sing a Song of Sixpence* (1866), *Beauty and the Beast* (1874), *Little Red Riding Hood* (1875), and *Aladdin* (1875). Crane created some of his best illustrations for two books of nursery rhymes set to music by his older sister, Lucy. The books were called *The Baby's Opera* (1877) and *The Baby's Bouquet* (1878). Crane also illustrated adult books, as well as oil paintings, murals, and posters. In addition, he designed tapestries and wallpaper. He was born in Liverpool on Aug. 15, 1845.

Marilyn Fain Apseloff

Crane fly. See Daddy longlegs.
Cranium. See Head.

Cranmer, Thomas (1489-1556), was the first Protestant archbishop of Canterbury, the leader of the Church of England. He became a leading figure of the English Reformation, which was the movement that led to the establishment of Protestantism in England.

Cranmer was born on July 2, 1489, at Aslockton, in Nottinghamshire. He attended Cambridge University, was a fellow of Jesus College, and was ordained as a priest by 1520. King Henry VIII noticed Cranmer in 1529, when Cranmer met with the king's advisers concern-

ing Henry's attempts to *annul* (cancel) his marriage to Catherine of Aragon. Cranmer suggested that the question of whether the marriage should be annulled be put to theologians at the universities for judgment rather than to the pope. In 1532, he was sent as part of a delegation to Europe, which met with political leaders and theologians. In Germany, he also married the niece of a religious reformer. He kept the marriage secret because the marriage of priests was still illegal in England. In 1533, Cranmer became archbishop of Canterbury. He annulled Henry's marriage to Catherine, and he supported Henry's efforts to separate the Church of England from the Catholic Church. See **Henry VIII** (of England).

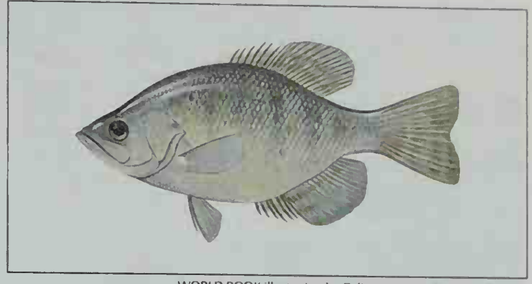
During Henry's reign, Cranmer authorized using an English language Bible in parish churches and published an English version of a *litany,* a form of prayer. In the reign of Edward VI, Cranmer organized the preparation of the *Book of Common Prayer* (1549). He also shaped a statement of doctrine that eventually became the Thirty-Nine Articles of the Church of England.

In 1553, Mary, the daughter of Henry VIII and Catherine of Aragon, came to the English throne. Mary, a devout Roman Catholic, had Cranmer imprisoned. In 1554, he was charged with heresy. Two years later, he was burned at the stake. Dale A. Johnson

Cranston, Alan MacGregor (1914-2000), a Democrat from California, was a United States senator from 1969 to 1993. He served as Democratic *whip* (assistant leader) of the Senate from 1977 to 1990. In 1991, the Senate Ethics Committee reprimanded Cranston for his dealings with Charles H. Keating, Jr., an American banker. An investigation by the committee had concluded that Cranston acted improperly by using his political influence on Keating's behalf at the same time the senator was accepting large campaign contributions from Keating. Cranston denied that he had done anything improper. Cranston also was an unsuccessful candidate for the 1984 Democratic presidential nomination. He served as chairman of the Senate Veterans' Affairs Committee from 1987 to 1993.

Cranston was born in Palo Alto, California, and graduated from Stanford University in 1936. He worked as a correspondent in Europe and Ethiopia for the International News Service (INS) until 1938. In 1942, Cranston became chief of the foreign language division of the Office of War Information. From 1947 to 1958, Cranston headed a real estate firm in Palo Alto. He helped found the California Democratic Council in 1953 and served as its first president until 1957. Cranston held office as controller of California from 1959 to 1967. William J. Eaton

Crappie, *KRAP ee* or *KRAHP ee,* is a freshwater fish closely related to sunfish and black bass. It is found in sluggish, shallow waters of the Midwestern and Southern United States. The crappie is silvery olive with dark-green spots. It is about 1 foot (30 centimeters) long when full grown. It has a high fin on its back and a similar one on its belly. The *white crappie* has up to six spines in the back fin, and the *black crappie* has seven or more spines in the back fin. Crappies have large mouths. They feed on insects, small fishes, and other animals. They are an excellent food fish and an important game fish. Crappies are called by many other names, including bridge perch, bachelor perch, chinquapin perch, strawberry bass, calico bass, and sacalait. Robert D. Hoyt



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd

The white crappie is a popular freshwater game fish and food fish. It measures about 1 foot (30 centimeters) long.

Scientific classification. The crappie is in the sunfish family, Centrarchidae. The white crappie is *Pomoxis annularis.* The black crappie is *P. nigromaculatus.*

Crassus, *KRAS uhs,* **Marcus Licinius,** *MAHR kuhs lih SIHN ee uhs* (112?-53 B.C.), was a Roman statesman, financier, and military leader. In 60 B.C., Crassus, Caesar, and Pompey formed the *First Triumvirate,* a three-man political alliance that attempted to dominate Rome (see **Caesar, Julius; Triumvirate**). Crassus had previously held the high government posts of praetor, consul, and censor. He was called *the Rich* because he made much money through real estate investments.

In 71 B.C., Crassus had crushed the revolt of the gladiator Spartacus (see **Spartacus**). Seeking further glory, Crassus attacked Parthia, an empire in central Asia. In 53 B.C., Parthian archers trapped his army and killed Crassus and most of his troops. Arthur M. Eckstein

Crater is a funnel- or bowl-shaped depression on the surfaces of planets and other bodies in the solar system. Most craters on the earth are formed by volcanic activity. Some of these craters result from explosions that blast cinders and other debris from volcanic vents. Such craters are rarely larger than 1 $\frac{1}{4}$ miles (2 kilometers) across. Other craters form when the ground surface collapses following the withdrawal of lava from below. The depression occupied by Crater Lake in Oregon and the crater of Kilauea in Hawaii were both formed by collapse. Collapse craters larger than $\frac{3}{5}$ mile (1 kilometer) across are called *calderas.* Smaller collapse craters are called *pit craters.* Craters are common on the moon and on planets other than the earth. But almost all the craters on these bodies are *impact craters* that were formed by the impact of large meteorites. See also **Meteor** (Impact craters and basins; picture); **Moon; Satellite** (Types of satellites). Michael H. Carr

Crater Lake is the deepest lake in the United States. It lies in the crater of Mount Mazama, an inactive volcano in the Cascade Mountains of Oregon. The lake is almost 6 miles (10 kilometers) across at its widest point. It covers 20 square miles (52 square kilometers). Its surface is about 6,200 feet (1,900 meters) above sea level. Its greatest depth is 1,932 feet (589 meters). There are no known outlets and no streams flowing into it.

The lake was formed about 7,700 years ago when the top of Mount Mazama, then about 12,000 feet (3,660 meters) high, collapsed. This left a huge "bowl" which gradually filled with water. A small volcano called Wizard Island formed in the lake when lava erupted later from the interior of Mount Mazama.



George Schwartz, FPG

Crater Lake, in the Cascade Mountains of southwestern Oregon, is the deepest lake in the United States. It reaches 1,932 feet (589 meters) at its greatest depth. The lake lies in the crater of Mount Mazama, an inactive volcano. It is part of Crater Lake National Park.

The Klamath Indians believed the lake's waters had healing qualities. John Hillman, a mining prospector, arrived at Crater Lake in June 1853. He named it Deep Blue Lake. The area was made a national park in 1902. Originally, there were no fish in Crater Lake. But the lake was stocked with several varieties of fish from the late 1800's until 1941. Some rainbow trout and kokanee salmon still survive there. Gary H. Searl

See also **Volcano** (Composite volcanoes).

Crater Lake National Park was created in southwestern Oregon to preserve Crater Lake and the forests around it. The walls of an ancient volcano, Mount Mazama, rise from 500 to 2,000 feet (152 to 610 meters) above the surface of the lake. They have been changed by the weather into fantastic forms. Several peaks of the Cascade Mountains, including Mount Scott, Cloud Cap, and Llao Rock, rise near Crater Lake. Coniferous trees cling to broken rocks around the lake and are often reflected by the waters. There are more than 500 kinds of ferns and flowering plants in the meadows and on the slope of the volcano. Animals and birds are plentiful. President Theodore Roosevelt set 10 Oregon townships aside in 1902 to create the park. For its area, see **National Park System** (table: National parks).

Critically reviewed by the National Park Service

Crawford, William Harris (1772-1834), an American politician and statesman, became a Southern leader in United States politics. His Democratic-Republican Party believed in an extreme form of states' rights, the idea that the states retain all powers not given to the national government.

Crawford was a U.S. senator from Georgia from 1807 to 1813. He served as U.S. secretary of the treasury under Presidents James Madison and James Monroe from 1816 to 1825. In 1824, he ran for president but lost to Secretary of State John Quincy Adams. Crawford was born in Amherst County, Virginia. James C. Curtis

Crayfish, also called *crawfish,* is a freshwater animal that is closely related to the lobster. More than 300 species of crayfish live in North America. Crayfish are also common throughout Australia, Europe, and parts of Asia. Their habitats include lakes, swamps, and streams. Most crayfish measure from 2 to 6 inches (5 to 15 centimeters) long.

Crayfish belong to a group of animals called *crustaceans.* Like other crustaceans, they are covered by a hard, protective structure known as the *exoskeleton.* As a crayfish grows, it *molts* (sheds) its exoskeleton periodically and grows a new, larger one.

The body of the crayfish is divided into three main sections: (1) the head, (2) the thorax, and (3) the abdomen. The head and thorax are rigid, but the abdomen has flexible parts. Five pairs of legs extend from the sides of the thorax. The front pair are shaped into large claws. Several small reproductive structures called *swimmerets* hang from the abdomen.

Crayfish eat many kinds of plants, as well as snails, tadpoles, and fish. They are generally more active at night, returning to safety under a stone or inside their burrow during the day. When they are molting, crayfish lose the protection of their exoskeleton. As a result, they typically hide from their enemies for several days until a new exoskeleton hardens. In North America, crayfish are a favorite food of smallmouth bass and other sport fish. For this reason, crayfish are often used as bait by fishing enthusiasts.

Crayfish are a popular food in some parts of the world, particularly the Southern United States and the Scandinavian countries. In the United States, especially in southern Louisiana, crayfish are harvested from their natural habitats and raised on commercial "farms."

Gregory M. Capelli

Scientific classification. Crayfish belong to the order Decapoda. North American species belong to the families Astacidae and Cambaridae.

WORLD BOOK illustration by James Teason

Crayfish

See also **Crustacean; Lobster; Molting.**

Crayon is a stick of colored wax shaped like a short pencil. Colored pencils, colored chalk, and *pastels* (sticks made of a chalky paste) are sometimes called crayons. This article discusses wax crayons.

Children use crayons to create bright, colorful drawings. Crayons are often a child's first drawing tool. Artists sometimes use crayons to add texture to their works, by melting the wax or by other techniques.

To make crayons, manufacturers add natural or synthetic *pigments* (coloring materials) to heated wax. The mixture is then poured into molds. After the crayons harden, they are wrapped in paper.

No one knows exactly when wax crayons were invented, but they were used in Europe by the 1700's. Crayons were first made in the United States by Binney & Smith in Easton, Pa., in 1903. Eric Zebley

See also **Pencil** (Colored pencils).

Crazy Horse (1844?-1877) was an Oglala Sioux Indian chief. In 1875, the United States government ordered Crazy Horse and other Sioux to enter a reservation. They refused. In 1876, Crazy Horse led the Sioux and Cheyenne, who defeated General George Crook in the Battle of the Rosebud in Montana. Eight days later, he led the Indians in the Battle of the Little Bighorn, where Lieutenant Colonel George A. Custer and his command were wiped out (see **Custer, George Armstrong**).

As a boy, Crazy Horse was named Curly. After his first great war deed, his father, who was himself named Crazy Horse, gave his name to the boy. Crazy Horse had light skin and hair. He had a quiet manner. He had unusual spiritual powers. The Sioux called him their "Strange One."

In 1877, Crazy Horse voluntarily surrendered to American troops. Crazy Horse was killed in 1877 at Fort Robinson, Nebr., by a soldier while the chief was being forced into a jail cell. A gigantic figure of Crazy Horse is being sculptured out of a mountain in the Black Hills of South Dakota. Jerome A. Greene

Cream. See **Milk** (table); **Butter.**

Creasey, John (1908-1973), an English author, became one of the best-known writers of detective stories of the 1900's. He published more detective fiction than any other writer of his time—almost 600 novels written under 28 names. Most critics consider Creasey's stories uneven in quality but have praised his best ones for their fast-paced action and clever plots.

Creasey created several detectives. Under his own name, he wrote three separate series of novels about Inspector Roger West of Scotland Yard and two amateur detectives, Dr. Stanislaus Palfrey and Richard Rollison. Rollison is known as the Toff, an English slang word for a stylishly dressed man. Perhaps Creasey's most popular detective is Commander George Gideon of Scotland Yard. Under the name of J. J. Marric, Creasey wrote the Gideon series, the best example of the British police procedural novel. Creasey's other pen names include Gordon Ashe, Norman Deane, Michael Halliday, Kyle Hunt, and Jeremy York. Creasey was born in the county of Surrey. David Geherin

Creation. See **Life** (The origin of life).

Creationism is a set of beliefs based on the idea that a Supreme Being brought into existence the earth and all its life through a direct act of creation. Most creationists are conservative Christians who base their beliefs on the Bible's account of the Creation. Creationists include people of many different Christian faiths.

Creationist beliefs. There is considerable variation in creationist beliefs. *Strict creationists* take the Biblical story of the Creation literally. They believe that God created the universe just thousands of years ago, and that He created all life forms within six 24-hour days. Other creationists interpret the Bible more loosely. For example, some think the universe is millions or billions of years old, but that human beings were created only thousands of years ago. All creationists believe that each *species* (type of life form) on earth has remained relatively unchanged since the Creation, and that no species has evolved from any other. Most creationists base their beliefs on the Bible alone. Some, however, called *scientific creationists,* argue that there is scientific evidence supporting their viewpoint.

Creationists reject the theory of evolution, which nearly all scientists have adopted as a basic idea of modern biology. The theory of evolution first gained widespread attention when it was presented by British naturalist Charles R. Darwin in 1858. It states that the earth came into being about $4\frac{1}{2}$ billion years ago and that one basic life form evolved since then into the more than 2 million species that inhabit the world today. Modern human beings, according to the theory, first appeared about 100,000 years ago, after evolving from earlier human and prehuman ancestors. Most Christians who are not creationists accept the theory of evolution, believing the process was guided by God.

Early theories about the Creation. Modern Christian creationist belief stems from a time line published in the 1650's by James Ussher, an archbishop of the Church of Ireland. Ussher constructed the time line by interpreting literally the birth and death dates of figures in the Bible. According to Ussher, God created the earth and its life forms in 4004 B.C. Today, however, considerable disagreement exists among creationists concerning the date of what they believe was the Creation.

In the 1700's and 1800's, Ussher's ideas were called into question by the theory of evolution and other scientific developments. Christian leaders argued increasingly among themselves about the role of science in understanding Biblical accounts of the Creation. Some maintained the Bible should still be the basic source for information on the origin of the earth and its life.

The 1900's. In the early 1900's, public high schools in the United States began teaching evolution in science classes. In the 1920's, creationists proposed laws in 20 states to ban public schools from teaching evolution. They considered the teaching of the theory to be part of a dangerous trend toward the separation of religious beliefs from everyday life. Several states, including Arkansas and Tennessee, passed such legislation. The American Civil Liberties Union (ACLU) opposed the laws, saying that they violated the constitutional principle of the separation of church and state. The ACLU challenged the Tennessee law in 1925 by defending a teacher named John T. Scopes, who had volunteered to stand trial on the charge of teaching evolution.

The ACLU lost the Scopes case, and the laws against teaching evolution remained in effect. However, public opinion of creationism suffered as a result of the trial because the press portrayed creationists as uninformed and out of touch with mainstream science.

In the 1960's, more public schools again began to teach evolution, in part because of a fear that the United States was falling behind other nations in the teaching

of science. In 1968, the Supreme Court of the United States ruled that laws banning the teaching of evolution were unconstitutional because they made religion part of the curriculum. Despite these setbacks, the creationist movement gained strength in the 1960's.

In the 1970's and early 1980's, scientific creationists proposed laws that would have made creationism a required subject in classrooms that taught evolution. These people argued that creationism, like evolution, is based on science and so should be taught along with evolution. They also said that because evolution is "just a theory," it should be considered a religion. Thus they claimed that teaching only evolution would violate the Constitution both by limiting academic freedom and by supporting one religion over another.

In 1981, Arkansas and Louisiana passed laws requiring the teaching of creationism in public schools. But the laws were declared unconstitutional—the Arkansas law by a U.S. district court in 1982 and the Louisiana law by the U.S. Supreme Court in 1987. The courts ruled that the theory of evolution was scientific rather than religious. They also concluded that creationism was essentially a religious explanation of life and that the Arkansas and Louisiana laws were therefore unconstitutional because they favored one religion over another.

After the Supreme Court's 1987 ruling, creationists began to shift their focus away from state legislatures and federal courts. Instead, they tried to strengthen their influence through increased political activity in local school districts and communities. To avoid constitutional limits on teaching a specific religion, they called for schools to teach such theories of life as "abrupt appearances" and "intelligent design." These theories do not refer to God, but they do state that species appeared suddenly rather than evolving from earlier forms of life. Creationists have successfully used this approach to persuade a number of school districts to include discussion of creationism in science curriculums.

Raymond A. Eve

See also **Evolution** (Acceptance of evolution); **Scopes trial.**

Crécy, *KREHS ee* or *kray SEE,* **Battle of,** was the first important battle of the Hundred Years' War (1337-1453). It took place in 1346 at the site of the present village of Crécy, in the French department of Somme. English troops under Edward III defeated a much larger French army under Philip VI. Almost half the French force was killed in the battle, including more than a thousand knights. English archers on foot proved more effective than armor-clad French knights on horses. The hero of the battle was Edward, the Black Prince, son of Edward III of England. C. T. Allmand

See also **Edward** (the Black Prince); **Edward III; Hundred Years' War.**

Credit, in education. See **Universities and colleges** (Curriculum).

Credit enables people to obtain goods or services even if they do not have enough money to pay for them right away. For example, a person who cannot immediately pay the full price of an automobile or a house may make the purchase on credit.

The word *credit* comes from the Latin word *credo,* meaning *I trust.* Moneylenders trust borrowers to pay them back. Sellers extend credit to buyers because it increases sales and, ordinarily, the buyers pay interest. Buyers are willing to pay interest for credit because in this way, they can use things they want while they are still paying for them.

A *credit rating* establishes the extent to which a person or company can buy on credit or borrow money. Factors that contribute to a credit rating include income, financial reliability, and records of previous credit transactions. Organizations called *credit bureaus* compile credit ratings and provide this information to stores, business firms, and lending institutions.

Credit can promote economic growth and contribute to a nation's wealth. Business companies use credit to build factories or to buy equipment in order to increase the production of goods. Governments use credit to build schools, highways, and other public projects.

Types of credit. There are three major types of credit—*consumer, commercial,* and *investment.*

Consumer credit enables consumers to spend more money than they have at the time. A charge account is one kind of consumer credit. Most charge accounts involve no interest, but the full price of items bought through a charge account must be paid monthly. If the full amount is not paid by the specified date, many charge accounts require interest payments. Most businesses that provide charge accounts give their customers *credit cards* to make credit buying convenient. Banks also issue credit cards that can be used to charge purchases at many stores, restaurants, and other businesses. Another kind of consumer credit is an installment plan. Payments for a purchase on an installment plan are made over a stipulated period of time and, in most cases, include interest.

Commercial credit is used by companies to develop their business. They expect to repay the loans from their increased profit. Most of these loans are repaid within six months and so are called *short-term credit.*

Investment credit is a loan paid back over a period as long as 30 years, or even more. This kind of loan is called *long-term credit.* Examples include home mortgages and corporate bonds. Businesses use investment credit to undertake a major project, such as the construction of a factory.

Lending institutions take money received from savers and other customers and lend it on credit to those who need funds. Such institutions include banks, savings and loan associations, credit unions, finance companies, and insurance firms.

The terms of a loan are set forth in a loan contract. These terms include *interest, maturity,* and *collateral.* Interest is paid by the borrower to the lender. It serves as compensation for giving up the use of the money, for waiting for repayment of the loan, and for risking the loss of the money. Maturity is the date by which the loan must be completely repaid. Collateral is something of value that a borrower pledges to the lender in case the loan is not repaid as promised. For example, the title of a house is the collateral on a home mortgage.

Credit and the economy. The availability of credit affects both the rate of economic growth and the level of prices. When credit is easy to get, people are able to buy more, and their demand for goods and services grows. In response to the growing demand, business companies may try to hire more workers to increase

output. Credit also enables firms to buy new equipment to boost production. However, if output does not keep pace with demand, prices will increase. A continuing increase in prices is called *inflation*.

During periods of inflation, moneylenders may hesitate to grant credit. Inflation drives down the purchasing power of money, and so the dollars that lenders get back buy fewer goods and services than those they lent. If lenders expect a period of inflation to continue, they may raise interest rates to make up for the loss in money value. When credit becomes harder to obtain, economic activity may decline, and inflation may slow down or even stop. Frank J. Bonello

Related articles in *World Book* include:

Bank	Finance company	Mortgage
Collection agency	Inflation	Pawnbroker
Credit card	Installment plan	Savings and loan association
Credit union	Interest	
Farm Credit System	Loan company	

Credit card allows people to charge goods and services at business places that accept the card. Many types of firms issue credit cards. To obtain one, a person must have a record of paying bills on time. Each credit card has the cardholder's name and account number. The cardholder presents the card when making a purchase.

Many oil companies and department and chain stores issue credit cards that may be used only at their own establishments. Travel and entertainment card companies and many banks issue cards that the cardholder may use at a variety of hotels, restaurants, stores, and other businesses. The banks and the card companies pay the businesses for purchases but deduct a fee for the service. In addition, travel and entertainment card companies and many banks charge cardholders an annual fee.

Cardholders receive a monthly bill. Most types of credit cards permit cardholders to pay only part of the bill if they wish. But cardholders then must pay a finance charge on the unpaid part.

Cards called *debit cards* resemble credit cards. But when a cardholder uses a debit card, the amount of the purchase is typically deducted directly from the cardholder's checking account. Frank J. Bonello

Credit Mobilier of America, *moh BEEL yuhr* or *moh BEEL yay,* was a joint-stock company responsible for a major political scandal in the United States. It was first chartered in 1859 as the Pennsylvania Fiscal Agency. In 1864, the agency came under the control of the Union Pacific Railroad Company, which renamed it Credit Mobilier and made it the railroad's construction company. In effect, the same men owned the Union Pacific and Credit Mobilier, and they awarded the railroad's construction contracts to Credit Mobilier. Under the Pacific Railroad Acts of 1862 and 1864, the federal government gave the Union Pacific large loans and land grants to build a transcontinental railroad to the West Coast. In building the railroad, the Union Pacific paid unreasonably high bills submitted by Credit Mobilier, and the Credit Mobilier owners benefited immensely.

The managers of Credit Mobilier tried to ensure that the U.S. Congress did not question the way the railroad managed its business. They did this by offering Credit Mobilier stock at far below market value to certain key congressmen and other federal government officials. The participants were even allowed to pay for the stock out of dividends they expected to earn from it. Oakes Ames, the head of Credit Mobilier and a member of the U.S. House of Representatives, secured the participation of several important officials. Those accused of participating included Representatives Schuyler Colfax and James A. Garfield and Senator James W. Patterson. Colfax became Vice President of the United States in 1869. Garfield served as President in 1881.

Credit Mobilier's dealings were revealed in 1872. Congress investigated the company and issued two reports. But it did little more than to *censure* (officially condemn) Ames, Patterson, and Representative James Brooks, another participant in the scandal. Ames argued that Credit Mobilier should not be singled out for criticism because similar financial manipulation and bribing of congressmen were widespread. The scandal resulted in mounting criticism by reformers of the standards of public morality in the 1870's. Michael Perman

Credit union is a cooperative banking association operated exclusively for the benefit of its members. The members pool their savings and borrow money at a rate of interest sometimes lower than the interest charged by most banks. Credit unions are often organized among the employees of companies or members of farm groups, labor unions, and educational, religious, and social institutions. In the mid-1990's, there were about 13,000 credit unions in the United States with a membership of over 65 million. The unions had assets of about $300 billion. Deposits are insured up to $100,000 per account by the federal government.

Cooperative credit societies originated in Germany during the 1840's. Alphonse Desjardins organized the first credit union in North America in 1900 in Lévis, Quebec. Desjardins helped set up the first credit union in the United States in Manchester, N.H., in 1908. In 1909, Massachusetts became the first state to legalize credit unions. Desjardins helped draft the new law. Boston merchant Edward A. Filene became a leader in the development of American credit unions. Today, more than half of all credit unions in the United States operate under federal charters and are supervised by the National Credit Union Administration. The others are chartered by individual states. William G. Dewald

Cree Indians are a people who live in Canada and in Montana in the United States. They form a number of bands that speak various dialects of a single Algonquian language. All Cree once lived in the forests of eastern and northern Canada. In the late 1600's, they began to trade furs to Europeans for weapons, traps, and other items. During the mid-1700's, some bands of Cree moved onto the grassy plains of Alberta and Saskatchewan. The Indians who moved west, called the Plains Cree, became buffalo hunters. Today, many Cree farm on reservations. Others live in Canadian cities.

The Cree who remained in the Canadian forests became known as the Woodlands Cree. They continued to take part in the fur trade. Until the 1950's, the Woodlands Cree lived in small groups of a few related families. They lived in tents covered with hides or birchbark or, later, canvas. Today, most Woodlands Cree live in cabins or frame houses in villages. They earn money by trapping animals for furs, by catching and processing fish, and by mining and other wage labor. The Canadian government employs some Cree as health-care workers,

teachers, and clerks. The Cree believe in an almighty spiritual power, which they call *manito.*

At least 76,000 Cree live in Canada. About 2,000 Plains Cree live on a reservation in Montana. Alice B. Kehoe

See also **Poundmaker; Saskatchewan** (picture: Cree Indians).

Creed, American's. See American's Creed.

Creed, Apostles'. See Apostles' Creed.

Creed, Nicene. See Nicene Councils.

Creek Indians belong to any of 19 tribal groups that once occupied much of what are now Alabama and Georgia. Today, most of the approximately 20,000 Creeks live in Oklahoma. The largest Creek tribes are the Alabama and the Muskogee. They were called the Upper Creeks because they lived farther north than other Creek groups. Most other Creeks belong to the Yuchi or Hitchiti tribes, called the Lower Creeks.

European explorers first came in contact with the Creeks in 1540. By that time, several Creek tribes had joined together and formed the Creek Confederacy. The Creeks farmed the land and lived in about 50 small settlements called *Creek towns,* some of which had more than 1,000 persons. The Creek Confederacy grew in power during colonial times as it expanded to include tribes displaced by European settlers.

During the early 1800's, the Creeks fought a series of wars with white settlers who wanted their lands (see **Indian wars** [In the South]; **Jackson, Andrew** [The Battle of Horseshoe Bend]). In the 1830's, the government forced the Creeks to move to the Indian Territory in what is now Oklahoma. Few received any payment for their land, and most had to leave their belongings behind.

The Creeks faced poverty and starvation in the Indian Territory. But they developed crops and farming methods suitable for their new land and soon became fairly prosperous. Laws passed in the 1890's broke up tribal landholdings into areas that were given to individual Indians. But many of these areas were too small to be farmed profitably, and the Creeks were forced back into poverty. Today, many Creeks are poor. But others work in a wide range of fields, including education, law, and medicine. Don Whiteside

See also **Five Civilized Tribes.**

Creeley, Robert (1926-), an American poet, is one of a group of writers who are sometimes called the *Black Mountain poets.* This group, which includes Robert Duncan and Charles Olson, worked together at Black Mountain College, an experimental school in Black Mountain, N.C. Beginning in the 1950's, they developed a new kind of poetry based on Creeley's idea that "form is never more than an extension of content."

Creeley's poems are short and unrhymed, with few descriptive details. They often deal with "the tragedy of human relationships," such as strained communication between lovers, friends, or parents and children. Some poems suggest a playful or passionate struggle between the mind and body, and the self and world.

Robert White Creeley was born in Arlington, Mass. His poetry has been collected in *Collected Poems: 1945-1975* (1982) and *Selected Poems* (1991). A selection of his fiction and nonfiction was published as *The Collected Prose of Robert Creeley* (1984). Steven Gould Axelrod

Creeper is the name of many species of small, woodland birds that live in most parts of the world. The *brown creeper* is the only species found in North America. The brown creeper ranges from central Canada south into Mexico. Creepers measure about 5 inches (13 centimeters) long and have a long, thin bill. The upper parts of the creeper's body are mainly brown, and the underparts are white.

Creepers eat insects and spiders found on and in the crevices of bark. These birds search for food almost continually. They "creep" up tree trunks in quick, jerky movements, using their long, stiff tail as a prop. After reaching the treetop, creepers fly down to a different tree trunk and begin their upward hunting movements again.

Creepers make their nests behind loose flaps of bark. They build the nests of twigs, strips of bark, and feathers. The female lays 5 to 8 eggs, which are white but speckled reddish-brown. In the fall, creepers that live in regions with cold climates may migrate to warmer areas. Those that stay in cold regions often huddle together in groups of from 2 to 15 birds to stay warm.

Scientific classification. North American creepers belong to the tree-creeper family, Certhiidae. The scientific name for the brown creeper is *Certhia familiaris.* Richard F. Johnston

See also **Bird** (picture: Birds of Europe and Asia).

Cremation is burning a dead body to ashes. Burial is the most common method of disposing of the dead in most countries, but the practice of cremation is increasing in the United States, Canada, and Europe. Some people who request cremation consider burial in a cemetery to be undignified. Other people feel that burial is a wasteful use of land.

Most funeral directors can arrange a cremation. A funeral service may take place before or after the burning. The cremation is performed in a building called a *crematory* or *crematorium.* The body is put in a coffin or other container, which is burned in a special oven from one to four hours. The remaining bones are then crushed into white, powdery ashes. The ashes are placed in a container called an *urn* and given to the relatives of the dead person. The relatives may keep the ashes, bury them in a cemetery, or place them in a special burial vault called a *columbarium.* Some people request that their ashes be scattered in one particular place, such as a favorite lake.

Cremation has been practiced throughout history. It was not used by the ancient Chinese or Egyptians. But the ancient Greeks and Romans practiced it. They believed that burning the body purified the soul and released it from its earthly form. The early Christians believed in the eventual reuniting of the body and soul, and viewed cremation as a form of disrespect.

Cremation remained uncommon in Christian countries until the 1800's. Then concern about land use in urban areas and increasing opposition to church restrictions helped reawaken interest in cremation. The first legally recognized crematory for public use opened in Milan, Italy, in 1876. Crematories were first established in the United States in 1884. Today, cremations account for the disposal of about 10 percent of the dead in the United States, about 20 percent in Canada, and about 60 percent in the United Kingdom. Robert Fulton

Creole, *KREE ohl,* in North or South America, is a person whose ancestors were early French or Spanish settlers of the New World. The word *Creole* comes from

the Spanish word *criollo,* meaning *native to the place.* The term also refers to Creole foods and other aspects of Creole culture. In the United States, a Creole is a descendant of French and Spanish settlers of the Gulf States. Many Creoles speak a form of French, Spanish, or Portuguese. Creole foods include *gumbo,* a kind of soup; and *pralines,* a candy. See also **Cable, George Washington; New Orleans** (Ethnic groups).

James H. Dormon

Creosote, *KREE uh soht,* is a heavy, oily liquid made by distilling wood or coal tar. It has a penetrating, smoky smell and is nearly colorless when pure. Creosote as marketed is commonly a brownish color, and is a mixture of creosol and several other substances. Creosote oil taken from beechwood tar has been used in medicine. Creosote obtained by distilling coal tar is one of the most effective wood preservatives. It has been used for this purpose for more than 100 years. Other uses include disinfectants and solvents. However, creosote is poisonous. In addition, tests have shown that the substance causes cancer in laboratory animals and may cause cancer in human beings. In 1986, the United States Environmental Protection Agency (EPA) began restricting the use of creosote as a wood preservative. See also **Tar.** Bob Williams

Creosote bush, *KREE uh soht,* is a shrub that grows throughout the desert regions of the southwestern United States and Mexico. A number of related shrubs grow in the deserts of Argentina. Unlike most desert shrubs, the creosote bush is an evergreen. It grows about 5 to 8 feet (1.5 to 2.4 meters) high. It has many branches and produces a resin. The shrub has small yellow flowers. The fruit is round, with long, soft, white or reddish-brown hairs. The creosote bush is sometimes called *greasewood,* but it is not a true greasewood.

Creosote bushes often grow in rings. Some botanists suggest that such rings are colonies of identical plants. According to this theory, all the bushes in a ring are offshoots of one plant and may be thousands of years old.

Philip W. Rundel

Scientific classification. The creosote bush is in the family Zygophyllaceae. Its scientific name is *Larrea tridentata.*



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The creosote bush is an evergreen that grows in North American deserts. It has many branches and tiny yellow flowers.

Crescent, *KREHS uhnt,* is a symbol that resembles the moon in its first quarter. In heraldry, the crescent is a symbol of the second son in a family.

The people of Byzantium (now Istanbul, Turkey) used the crescent of Diana, a moon goddess in Roman mythology, as their symbol. When the Turks conquered the city, they adopted it as their symbol. It appears on the flag of Turkey. In addition, many countries with large numbers of *Muslims* (followers of Islam) feature a crescent on their national flags. The state flag of South Carolina also includes a crescent. Whitney Smith

Cress is any one of three green plants in the mustard family. They are used in salads and to garnish meats. The best-known cress plant is called *water cress* because it grows in water in sandy creek bottoms. It has smooth, bright-green leaves on long slender stems. *Garden cress,* or *peppergrass,* has a sharper taste than water cress. It grows in the Midwest. *Swedish cress,* sometimes called *upland cress* or *winter cress,* grows in Sweden. It is served as a vegetable there.

Water cress may be raised as a winter crop in greenhouses. It grows best in running water. Garden cress is usually planted in the early spring and harvested about six or seven weeks later. The cresses are rich in minerals but are usually eaten in too small amounts to provide much food value. Hugh C. Price

Scientific classification. Cresses belong to the mustard family, Brassicaceae or Cruciferae. The scientific name for water cress is *Nasturtium officinale.* Garden cress is *Lepidium sativum.* Swedish cress is *Barbarea vulgaris.*

See also **Mustard.**

Cretaceous Period, *krih TAY shuhs,* is a period in the geologic time scale of the earth's history. Scientists believe that the Cretaceous Period began about 145 million years ago and lasted 80 million years.

See also **Earth** (table: Outline of the earth's history).

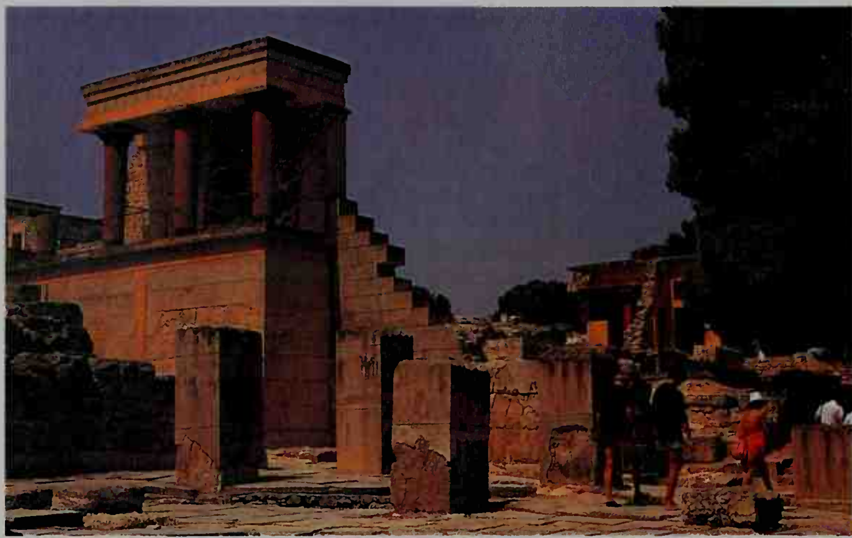
Crete, *kreet* (pop. 537,399), is the largest Greek island. It lies in the Mediterranean Sea, about 60 miles (97 kilometers) south of the mainland of Greece. For location, see **Greece** (political map). Crete was the birthplace of one of the first European civilizations, the Minoan culture. This civilization began about 5,000 years ago.

Crete covers 3,219 square miles (8,336 square kilometers). Khania is the capital of Crete. Iraklion is the largest city and chief port and commercial center.

People. More than 40 percent of Crete's people live in the island's three largest cities: Iraklion, Khania, and Rethimnon. Cretans speak Greek, and most belong to the Greek Orthodox Church. Cretans are proud of their past and follow many old customs. For example, people in rural villages perform traditional dances and folk songs in folk costumes. These activities occur chiefly during celebrations of weddings, baptisms, or religious holidays. However, most aspects of Cretan life, such as education and employment, are similar to those of mainland Greece.

Cretans often gather in cafes for such purposes as eating, playing backgammon, and discussing politics. Social life in Crete's cities becomes especially active during the cool summer evenings.

Land and climate. A chain of mountains extends across the center of Crete in an east-west direction. The highest point is Mount Ida, which rises 8,058 feet (2,456 meters) above sea level in central Crete. Fertile valleys



Knossos, Crete, is the site of famous ancient ruins of the Minoan civilization. The Palace of Minos at the ruins, *left,* was built about 1500 B.C. Crete was the birthplace of the Minoan culture, one of the first European civilizations. The Cretans made great advances in art, architecture, and engineering.

BB Pictures/TRIP © Eye Ubiquitous

and plains lie among the mountains, which drop off sharply to the sea along most of the southern coast. The mountains slope more gradually in the north, and a narrow plain extends along the northern coast.

Crete has a mild, dry climate. Temperatures average 53 °F (12 °C) in winter and 75 °F (24 °C) in summer. Rain falls chiefly from October to March and is heavier in the mountains than on the plains and valleys. A number of Crete's farming areas require irrigation because they do not get enough rain.

Economy. Tourism is an important part of Crete's economy. Each year, more than 1 million tourists visit Crete to see the ancient Minoan ruins at Knossos and Phaistos and the Minoan relics at the Archaeological Museum in Iraklion.

Agriculture employs more Cretans than any other economic activity. The main crops include carobs, citrus fruit, grapes, and olives. Most of Crete's manufacturing takes place in the northern coastal cities. Factory products include processed food, building materials, chemicals, paper, and textiles.

Government. Crete is governed by the central Greek government in Athens. The island is divided into four *nomoi* (departments), each headed by a *nomarch* (governor) appointed by the minister of the interior.

History. The first people to settle in Crete came from Asia Minor (now Turkey) about 6000 B.C. By about 3000 B.C., the Cretans had developed an advanced civilization. It is called the *Minoan* culture, after the legendary King Minos (see Minos). During the Minoan period, the Cretans made great advances in art, architecture, and engineering. They built beautiful palaces with spacious courtyards. They excelled at making pottery and jewelry and also used a system of writing. For more information, see Aegean civilization (The Minoan culture).

Fire destroyed many towns and palaces of Crete after about 1450 B.C., and the civilization gradually declined. The Romans invaded the island in 68 B.C. and made it a province in 66 B.C. After the division of the Roman Empire in A.D. 395, Crete came under Greek rule as part of the Byzantine Empire. Venice ruled the island from 1204 to 1669. The Ottoman Empire conquered Crete and ruled it from 1669 to 1898.

A movement for union with Greece developed in Crete during the 1800's, and Crete became part of Greece in 1913. German forces conquered Crete in 1941, during World War II. The Germans controlled the island until several months before the war ended in 1945. After the war, Crete greatly improved its roads and tourist facilities. Today, it ranks as a major attraction for visitors to Greece. John J. Baxevanis

See also Architecture (Minoan architecture); Clothing (Ancient times; pictures); Knossos.

Cretinism, *KREE tuh nihz uhm,* is a condition in which babies are born with underdeveloped brains and poorly formed skeletons. Individuals afflicted with cretinism are called *cretins.*

Cretinism is caused by the failure of the thyroid gland to begin functioning during the development of a *fetus* (unborn child). The thyroid gland produces hormones necessary for growth and maturation of the body and brain. It normally begins functioning during the 12th week of fetal development. The absence of thyroid hormones disrupts normal growth patterns.

Doctors treat cretinism with supplemental thyroid hormones. Treatment must begin in the first six weeks after birth to prevent both physical and mental retardation. Charlotte H. Greene

See also Thyroid gland.

Creutzfeldt-Jakob disease, *KROYTS fehlt YAH kahb,* is a rare disease that destroys the brain. Two German neuropsychiatrists, Hans G. Creutzfeldt and Alfons M. Jakob, first described the disease in the 1920's. The earliest symptom is usually loss of memory. Within weeks, visual disturbances, lack of coordination, and muscular jerking occur. Mental and physical deterioration progress rapidly to death, usually within a year. No treatment or cure has been discovered.

Scientists think that Creutzfeldt-Jakob disease occurs when a brain protein called *prion protein* is changed into an abnormal form. In most cases, the cause of the transformation is unknown. The disease strikes about 1

out of 1 million people worldwide, usually between the ages of 50 and 75. In the 1990's, an unusual outbreak affected people in their teens and 20's in the United Kingdom. In 1996, British experts announced that these cases might have been caused by eating beef from cattle with a prion disease called *mad cow disease.* See **Mad cow disease; Prion.** Stanley B. Prusiner

Crèvecoeur, *krehv KUR,* **Michel-Guillaume Jean de,** *mee SHEHL gee YOHM zhahn duh* (1735-1813), was a French-born essayist who portrayed rural life in colonial America. His descriptions of the attitudes and hopes of the colonists persuaded many Europeans to settle in America.

Crèvecoeur was born on Jan. 31, 1735, near Caen, France. When he was 19 years old, he went to Canada to fight with the French during the French and Indian War. In 1769, he bought a farm near Chester, New York, and began his literary career.

Crèvecoeur wrote under the pen name of J. Hector St. John. He became best known for 12 essays collected in *Letters from an American Farmer* (1782), written to an imaginary friend in England. The essays describe such scenes as children coming home from school during a snowstorm and families fleeing an Indian attack.

Crèvecoeur supported the British during the Revolutionary War in America (1775-1783). In his *Sketches of Eighteenth Century America* (published in 1925, after his death), he accused the patriots of greed and the abuse of power in their struggle for independence. Crèvecoeur served as French consul to the United States from 1783 to 1790 and spent the rest of his life in France.

Edward W. Clark

Crewel, also called *crewelwork,* is a form of embroidery done with woolen yarn. Most crewel has designs stitched on a background of plain, sturdy cloth. The yarn, which consists of two woolen threads twisted together loosely, is also called crewel. Crewel can be used to create almost any design. Many crewel embroideries show flowers and vines arranged in graceful patterns. Crewel may include any embroidery stitch.

Historians believe the ancient Israelites used crewel to decorate the Tabernacle, a tent in which they worshiped. The Bayeux Tapestry, a famous crewel wallhanging showing scenes from English history, was stitched in the late A.D. 1000's. Crewel decorated curtains and upholstery in many American and English homes of the 1600's and 1700's. Today, many people stitch crewel pictures and other items. Dona Z. Meilach

See also **Bayeux Tapestry** (picture).



WORLD BOOK photo

Crewel is a wool yarn used for embroidery. The yarn is stitched onto a plain cloth, following the design printed on the cloth.

Crib death. See **Sudden infant death syndrome.**

Cribbage is a card game for two, three, or four people. Each player keeps score on a *cribbage board,* using two *pegs.* The object of the game is to *peg* (score) 121 points. The invention of the game is credited to Sir John Suckling, an English poet who lived during the 1600's.

When two people play, they *cut* (divide) the pack and the one who exposes the lower card deals. Each player is dealt six cards and places two of them face down. These cards form the *crib,* which is used at the end of the hand. The nondealer cuts the rest of the cards and turns up the top card of the lower part of the pack. This is the *turnup* or *starter.* If the turnup is a jack, the dealer pegs 2 points for *heels.*

The nondealer begins by laying down a card and calling out its value. Face cards each have a value of 10, aces count 1, and all other cards have values equal to their spots. The dealer then lays down a card, adds its value to the first card, and calls out the new total. Keeping their cards separate, players continue to take turns playing a card until the value of the cards played totals 31. A player who reaches 31 exactly pegs 2 points. A player who cannot lay down a card without going beyond 31 must say "go." The other player then pegs 1 point for *go* after playing as many cards as possible without passing 31. Whenever a *go* occurs, the opponent of the one who last played begins a new count. During the play, a player can also score points by making the value of the cards total 15 (worth 2 points). Players can also score if they make a pair (2 points), three of a kind (6 points), or four of a kind (12 points). A run of three or more cards in sequence scores 1 point for each card in the run, provided that the cards are played consecutively.



WORLD BOOK photo by Ralph Brunke

In a cribbage game, the players keep their own score by moving two pegs on the special cribbage board.

After the players have played their cards, they count up and peg the total points for their hands. The nondealer's hand is counted first, followed by the dealer's hand and the crib. The turnup is included in the count of each hand. Each combination of cards adding up to 15 counts 2 points. A pair scores 2, three of a kind scores 6, four of a kind scores 12, and a run of three or more cards in sequence scores 1 point for each card. Four cards of the same suit (or five, counting the turnup) score a *flush,* worth 1 point per card. At the end of the hand, a player

holding a jack of the same suit as the turnup scores 1 point for *nobs*. The crib belongs to the dealer and is scored the same way as the other hands, except that only five-card flushes count. R. Wayne Schmittberger

Crichton, *KRY tuhn,* **Michael** (1942-), is an American author whose novels weave new technological possibilities and current social issues into imaginative, fast-paced plots. Crichton's stories may seem fantastic, but his skillful use of realistic detail makes them believable.

John Michael Crichton was born on Oct. 23, 1942, in Chicago. While attending Harvard Medical School from 1965 to 1969, he wrote a series of mysteries under pen names. After receiving a medical degree, he decided to become a writer. His scientific interests appear in the novels *The Andromeda Strain* (1969), *The Terminal Man* (1972), *Sphere* (1987), *Jurassic Park* (1990), and its sequel *The Lost World* (1995). Crichton has also used his novels to explore social issues. *Rising Sun* (1992) mixes intrigue with Japanese-United States business relationships. *Disclosure* (1994) deals with sexual harassment. *Airframe* (1996) describes the investigation of an airplane disaster. Crichton has directed several movies, including *Westworld* (1973) and *Physical Evidence* (1989). He also wrote and directed *The Great Train Robbery* (1978), based on his 1975 novel of the same name. William A. Kumbier

Crick, Francis H. C. (1916-), is a British biologist. He shared the 1962 Nobel Prize in physiology or medicine with American biologist James D. Watson and biophysicist Maurice H. F. Wilkins, also of the United Kingdom. Crick and Watson built a model of the molecular structure of *deoxyribonucleic acid* (DNA), the substance that transmits genetic information from one generation to the next. The model, resembling a twisted ladder, is called the *Watson-Crick model.* Later, Crick helped explain how DNA determines the development of living things. See **Cell** (The 1900's; picture: A model of a DNA molecule); **DNA**.

Originally a physicist, Crick was involved in the development of radar technology during World War II. He began research work in molecular biology at Cambridge University in 1949. In 1976, he became a research professor at the Salk Institute in San Diego. Born on June 8, 1916, in Northampton, England, Crick studied at London and Cambridge universities. Daniel J. Kevles

See also **Heredity** (The chemistry of genes); **Science** (picture: A ladderlike model of DNA); **Watson, James D.**

Tree cricket **House cricket**

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Cricket is a type of jumping insect related to grasshoppers. Crickets differ from grasshoppers in several ways. Crickets have a long, needlelike *ovipositor* that deposits eggs. The wings of most crickets lie flat over each other on top of their backs. Other crickets have only tiny wings or are wingless. The slender antennae are much longer than the body in most kinds of crickets.

Crickets are well known for their songs. These songs are produced mainly by the males. Each kind of cricket has a different song, usually trills or a series of chirps. Crickets make sound by rubbing their two front wings together. They hear sound with organs in their front legs. The songs help males and females find each other.

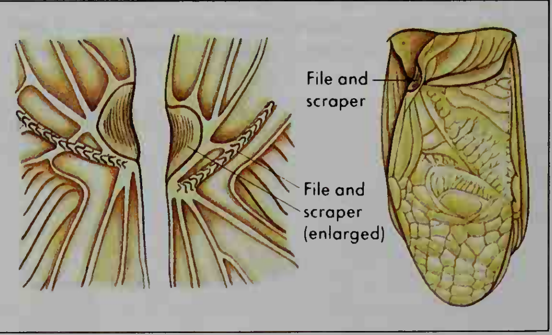
Crickets are commonly found in pastures and meadows, and along roads. Sometimes crickets enter houses. Crickets eat plants and the remains of other insects.

The best-known crickets are the *house cricket* of Europe and the *common, black,* or *field cricket* of the United States. These black or brown insects are about 1 inch (2.5 centimeters) long. *Tree crickets* are white or pale green. They live on trees and shrubs and feed on small insects called *aphids.* Male tree crickets sing in chorus. Their song is a high-pitched *treet-treet-treet.* The tiny *ant-loving crickets* are wingless and as broad as they are



E. R. Degginger

The common North American field cricket is known for its song. It grows about 1 inch (2.5 centimeters) long.



WORLD BOOK illustrations by Oxford Illustrators Limited

The organs with which the cricket "sings." At the right are shown the cricket's front wings, folded along its back so that the right wing nearly covers the left. At the left, portions of the wings are shown separated, with the sound-producing organs enlarged. Each wing has a "file," or thickened vein with crossridges, and a "scraper," or hard, sharp-edged portion. The scraper of either wing may be rubbed against the file of the other wing to produce the mating call.

long. They live in ants' nests and eat ants' young. *Mormon crickets, camel (cave) crickets, mole crickets,* and *Jerusalem crickets* are not considered true crickets (see **Mole cricket; Mormon cricket**). Betty Lane Faber

Scientific classification. Crickets are in the order Orthoptera and the cricket family, Gryllidae. The scientific name for the house cricket is *Acheta domesticus.* The common cricket is *Gryllus pennsylvanicus.* Tree crickets are genus *Oceanthus.* Ant-loving crickets are genus *Myrmecophila.*

See also **Grasshopper; Insect** (picture: The "ears" of a cricket).

Cricket is a game played with bats and a ball by two teams of 11 players each. It is especially popular in England and in many countries that once were British colonies. Cricket is played on a round or oval grass field. The action centers on two *wickets.* Each wicket consists of three wooden stumps and two sticks called *bails,* which rest on top of the stumps.

The teams take turns batting and fielding. A member of the fielding side called the *bowler* stands near one of the wickets. The bowler runs to the wicket and *bowls* (delivers) the ball with a stiff-armed motion at the opposite wicket. The ball bounces once in front of the wicket on most deliveries. A fielder called the *wicketkeeper* stands behind the wicket.

Members of the batting side are called *batsmen.* A batsman called the *striker* stands at the far wicket, facing the bowler, and tries to hit the ball with a long, flat-fronted bat. If the ball gets by and knocks a bail off the wicket, the striker is out. If the ball is hit into the field, the striker and a batsman called the *nonstriker*—a teammate at the opposite wicket—may try to score a run.

Only the striker can score a run. A run is scored each time the striker and the nonstriker run to the opposite wicket before a fielder can knock off a bail with the ball. Sometimes they can run back and forth several times before a fielder can return the ball.

The striker is the batsman who is at the wicket opposite the bowler when the ball is returned. The two batsmen remain *in* (at bat) until one of them is *dismissed* (put out). The batsman who is dismissed is replaced by a teammate. A major cricket match may last one day or up to five days, and each team may score hundreds of runs. The team that scores the most runs wins.

The field and equipment

The field may vary in size. Most fields on which official matches are played measure about 450 feet (137 meters) wide and 500 feet (150 meters) long. The wickets are 22 yards (20 meters) apart in the center of the field. They stand opposite and parallel to each other. The area between the wickets is called the *pitch.*

Each wicket measures 9 inches (22.9 centimeters) wide. The stumps of each wicket are close enough together so the ball cannot pass between any two of them. The tops of the stumps stand 28 inches (71.1 centimeters) above the ground. The bails are $4\frac{3}{8}$ inches (11.1 centimeters) long and rest in grooves on the tops of the stumps. The bails do not rise more than $\frac{1}{2}$ inch (13 millimeters) above the stumps.

White lines made by chalk or lime mark certain boundaries called *creases.* A line called the *bowling crease* is drawn through the stumps of each wicket. It is 8 feet 8 inches (2.64 meters) long, with the middle stump of the wicket at its center. A line called the *popping crease* is marked 4 feet (1.22 meters) in front of the bowling crease. The popping crease extends at least 6 feet (1.83 meters) on either side of the center of the wicket but is considered to be unlimited in length. Lines called *return creases* are marked from each end of the bowling crease. The return creases extend forward to the popping crease and back at least 4 feet behind the bowling crease. But the return creases are considered to be unlimited in length. The bowler must deliver the ball with some part of the front foot behind the popping crease. The back foot must be between the return creases.

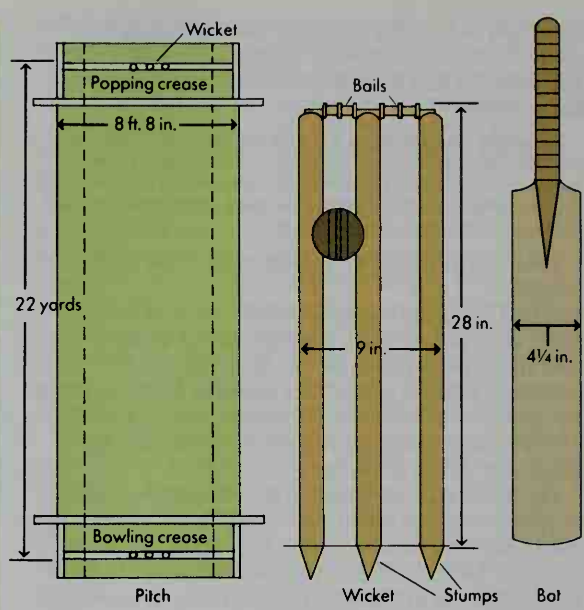
Equipment. The rules of cricket do not specify the material to be used in making a cricket ball. The best balls have a cork center wrapped with twine, and a leather cover. The ball must be between $8\frac{13}{16}$ and 9 inches (22.4 and 22.9 centimeters) in circumference, and it must weigh between $5\frac{1}{2}$ and $5\frac{3}{4}$ ounces (155.9 and 163 grams).

The bat cannot be more than 38 inches (96.5 centime-



Cricket players must have quick reflexes. The bowler, *center,* delivers the ball to a batsman from the opposing team. The batsman hits the ball and races back and forth between the wickets, trying to score as many runs as possible before fielders retrieve the ball.





WORLD BOOK illustrations by David Cunningham

Cricket field and equipment. The fielding positions, *left,* are those often used for a right-handed batsman. The positions vary according to the skills of the batsman and the bowler. The pitch is marked by batting and bowling creases. Stumps are close together so the ball cannot go between them. Bats vary in length.

ters) long nor more than $4\frac{1}{4}$ inches (10.8 centimeters) wide at any point. It must be made of wood. The bat has a round handle and a flat, bladelike hitting surface.

Cricket players wear peaked caps or helmets, open-necked shirts, trousers, and spiked or crepe-soled shoes. Batsmen and wicketkeepers wear protective leg pads and gloves.

The game

A cricket match may consist of one or two periods, each called an *innings.* First-class matches are played in two innings. A team's innings ends when 10 of its 11 players have been dismissed. But the captain of the batting side may declare the side's innings over at any time.

Team captains toss a coin to decide who will bat first. After the first innings of a two-innings match, the captain whose team batted first may order the opposing side to *follow-on* if the opposing side is behind by a certain number of runs. The opposing team must then bat its second innings immediately after its first innings. The opposing team may be ordered to follow-on if it is behind by 200 runs in a match of five days, by 150 runs in a three- or four-day match, by 100 runs in a two-day match, or by 75 runs in a one-day match. If the team that follows-on cannot catch up, the team that batted first wins *by an innings.* A team wins by an innings if it scores more runs in one innings than the opposing team scores in two innings. If the team that follows on takes the lead, the team that batted first can then bat its second innings.

A team may also win by a certain number of wickets. A team wins by wickets if it takes the lead during its second innings and the opposing team has already batted twice. If the team takes the lead after four batsmen have been dismissed, for example, it wins by six wickets because six batsmen have not been dismissed. If a match is not won by an innings or by wickets, the outcome is expressed by the number of runs scored by each team.

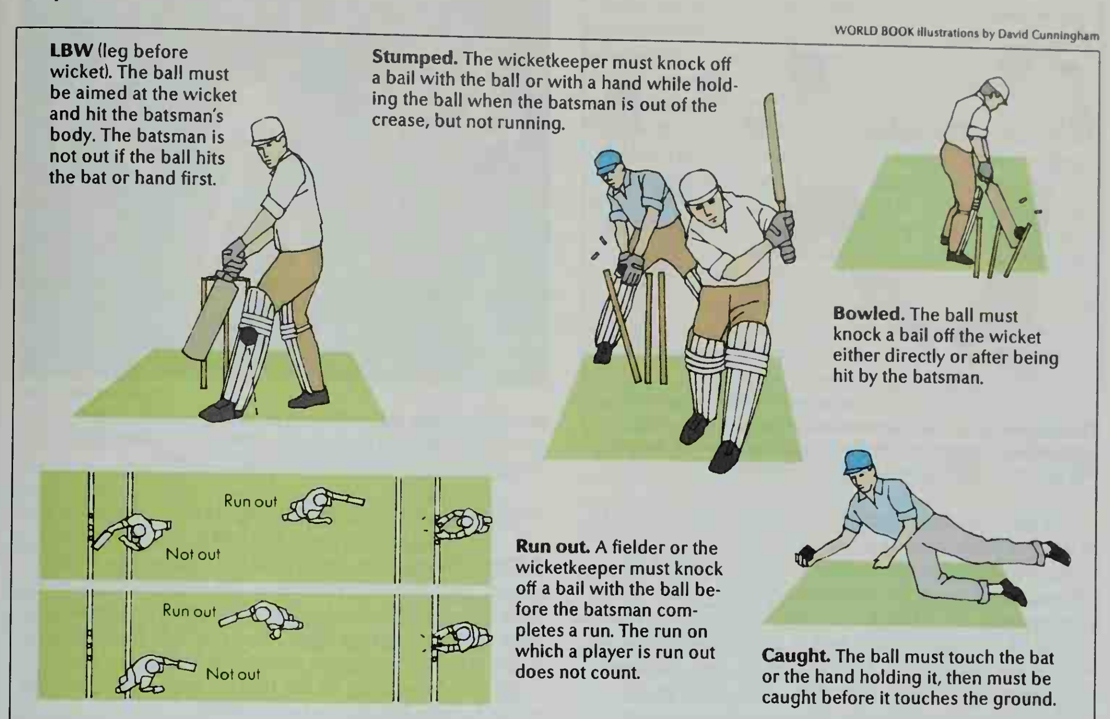
Scoring. Most runs are scored by running from one wicket to the other. Each runner must safely cross the opposite popping crease to score one run. Batsmen also score runs when they hit the ball out of bounds, known as a *boundary.* They score four runs when the ball rolls or bounces across the boundary line. They score six runs if the ball lands out of bounds without bouncing.

Runs called *extras* or *sundries* may also be scored in various ways. Sundries are scored on *byes, leg byes, wide balls,* and *no balls.* A bye is a run scored when the ball passes the striker without touching the bat or any part of the striker's body and without knocking off a bail. A leg bye is a run scored when the ball hits the striker anywhere but on the hands. A ball that hits the hands is played as if it had hit the bat.

A wide ball is a delivery that the umpire rules is out of the striker's reach. One run is automatically scored for a wide ball. The batsmen may attempt to score more runs by running from one wicket to the other before the ball is returned. A no ball may be called for certain rules violations. The main violations occur when (1) the bowler throws the ball instead of bowling it or (2) the bowler's feet are not in the proper position when the ball is delivered. A penalty of one run is scored for a no ball. But if a striker hits a no ball and the batsmen score runs, these runs are counted instead of the penalty.

Outs. There are several ways to dismiss a batsman. The most direct way is bowling a bail off the striker's wicket. Strikers are also out if they are *caught*—that is, if they hit a ball that is caught by a fielder before it

Ways to be out



bounces or that lands in a fielder's clothing without touching the ground. Either batsman may be *run out* when trying to score. A batsman is run out if a wicketkeeper or other fielder, while holding the ball in his hand, knocks a bail from the batsman's wicket while the batsman is between the popping creases. Strikers are out *stumped* if they step in front of the popping crease when not attempting a run and the wicketkeeper knocks off a bail. Strikers can be out *LBW* (leg before wicket) if they prevent a delivered ball from hitting the wicket by stopping it with any part of their body except the hands. They are also out if they *break the wicket* (knock off a bail) with their bat, clothing, or any part of the body while trying to hit the ball. Strikers are out if they hit the ball a second time except to keep it from hitting the wicket. If the striker or the nonstriker intentionally prevents a player from fielding the ball, the striker is out. Either batsman may be called out for intentionally touching a ball in play with a hand not holding the bat.

Umpires make sure the game is played according to the rules, and they settle all disputes. One umpire stands behind the bowler's wicket to make decisions on whether the striker is caught or out LBW, and to rule on run outs at the bowler's end. A second umpire stands to the side of the striker's popping crease to rule on a stumping or run out at that end.

The umpire at the bowler's end also decides whether the ball is in play. The ball is in play from the moment the bowler begins the run-up to the popping crease. The ball is *dead* (not in play) when (1) it is finally settled in the hands of the wicketkeeper or bowler, (2) it lodges in the clothing or equipment of a batsman or umpire, (3) it lodges in a fielder's helmet, (4) it has been called lost, (5) a boundary is scored, (6) a batsman is out, (7) a penalty is awarded after a fielder intentionally stops the ball with something other than the body, (8) the umpire calls "over" or "time," (9) the umpire suspends play because of an injury to a player, or (10) the umpire calls a case of unfair play.

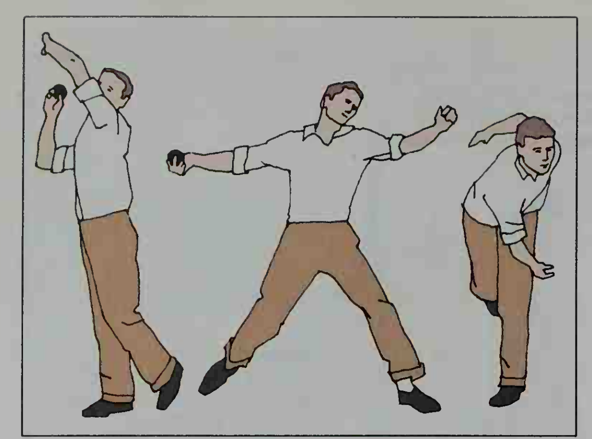
Playing cricket

The batting side. The order in which a team's batsmen will bat is decided by the captain. After a batsman is dismissed, a teammate takes a turn at bat until 10 players are out. One batsman always remains *not out.*

A batsman may hold the bat any way that is comfortable and effective. Batsmen should stand with their weight evenly distributed and the feet slightly apart. Most batsmen stand with one foot on each side of the popping crease. One of the great skills of batsmanship is the ability to hit the ball between the fielders.

The batting strokes may be divided into two categories, *forward play* and *back play.* Each may be used either (1) to attack and try to score runs or (2) defensively to protect the wicket. For both strokes, the batsman swings the bat back in a movement called the *back-lift,* then brings it forward and down past the feet to hit the ball.

On a forward stroke, the batsman moves the front foot forward near the path of the ball. When the ball is bowled slowly, the batsman may take two or three steps toward the ball, rather than one long step. A forward stroke is best for a ball that bounces near enough to the batsman to be hit on the *half-volley*—that is, as soon as it bounces off the ground. Forward strokes are usually made with the bat pointed down.



WORLD BOOK illustration by David Cunningham

The bowler looks over his shoulder at the point on which he wants to bounce the ball. He then brings his arm over, keeping it stiff to prevent jerking, and follows through after the release.

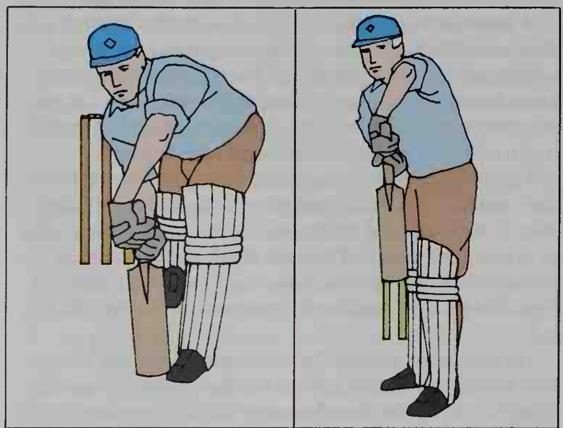


Roger Archibald, Shostal

Skillful bowlers deliver the ball at varying speeds. They try to confuse the batsman by changing speeds and making the ball change direction either before or after it bounces.

The back stroke is better for a ball that bounces so far in front of the batsman's wicket that the batsman can see which way the ball moves after it hits the pitch. When playing defensively, the batsman brings the back leg into the path of the ball and points the bat down. There should be no space for the ball to pass between the bat and the batsman's body. In attacking on back play, batsmen use a wide variety of strokes, depending on where the ball bounces and in what direction it moves. For example, they may swing the bat at an angle to the path of the ball with a *hook* or a *cut* stroke.

As soon as the bowler delivers the ball, the nonstriker should be *backing up* (moving toward the opposite wicket) and ready to run. Batsmen do not have to try to score if the ball is hit. On most hits that go in front of the popping crease, the striker decides whether it is possible to score. If it looks like both batsmen can safely reach the opposite popping crease, the striker calls to the nonstriker that they should try for a run. When the ball goes behind the popping crease, the nonstriker decides whether the batsmen should try to score. Misunderstanding between the batsmen is the main cause of run outs. A batsman may hit the ball in any direction.



WORLD BOOK illustration by David Cunningham

Batting strokes are used either to try to score runs or to protect the wicket. The batsman at the left uses a forward stroke to try to hit the ball into the field. At the right, he uses a back stroke to keep the ball from hitting the wicket.

The fielding side consists of the bowler, the wicket-keeper, and nine other fielders. The other fielders' positions vary in name and location. The most common positions are shown in the diagram of the field that appears in this article. The captain directs the fielders to various positions, depending on the bowler and on whether the striker is right-handed or left-handed.

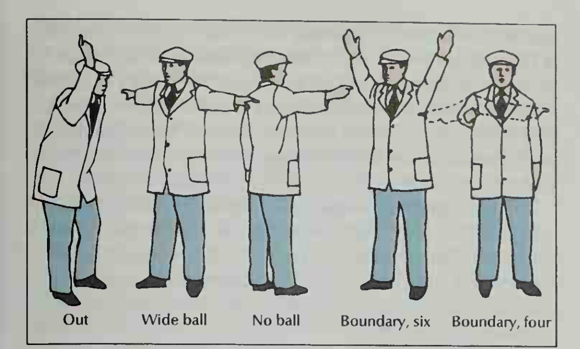
After the bowler has delivered a certain number of balls, the umpire calls "over." An over consists of six legitimate deliveries. Wide balls and no balls do not count in the total. After each over, the striker becomes the nonstriker and the nonstriker becomes the striker. Two successive overs cannot be bowled from the same end in one innings. In *limited-over* cricket, the game ends after a certain number of overs rather than after one or two innings.

Good bowling is based on coordinated body, arm, and shoulder motion. The run-up to the bowling crease is designed to give the bowler enough power and balance to bowl the ball at the desired speed. At the final stride, a right-handed bowler's left shoulder should point toward the batsman. When the bowler's left foot has swung forward, the right shoulder should move forward and point in the direction the ball will travel. The bowler's wrist must be loose and the hand cocked back before releasing the ball. For the most power, the bowler continues the arm motion after the release.

Bowlers try to deliver the ball so it bounces a short distance in front of the batsman. Such a delivery is difficult to hit because the batsman is uncertain whether to play forward or back. In addition, bowlers try to get batsmen out by changing the direction of the ball. Bowlers change the direction by controlling the ball's speed and by gripping and spinning the ball in special ways. They can thus make the ball *curve* (change direction in flight) or *break* (change direction after it bounces).

History

Cricket was probably first played in England, at least as early as the 1300's. It became a major sport there in the 1700's. The first printed rules appeared in 1744.



WORLD BOOK illustrations by David Cunningham

The umpires stand at either end of the pitch. They use arm signals to indicate their decisions to players and spectators.

Since 1788, cricket rules have been made and published in England by the Marylebone Cricket Club (M.C.C.).

In the earliest forms of cricket, the ball was bowled underhand, and bats were shaped like hockey sticks. In the mid-1800's, overhand bowling became legal, and batsmen began using bats like those of today.

The highest level of cricket is international competition called *Test matches.* The first Test match was played in 1877 between the United Kingdom and Australia in Melbourne, Australia. Today, the International Cricket Council regulates Test matches. Official Tests are played between nine teams, representing Australia, the United Kingdom, India, New Zealand, Pakistan, South Africa, Sri Lanka, the West Indies, and Zimbabwe.

Since 1882, a series of Test matches between the United Kingdom and Australia has been played for *the Ashes.* This term was first used after Australia had beaten the British in a match in London. After that defeat, a British newspaper printed a death notice of British cricket. The last words were: "The body will be cremated, and the ashes taken to Australia." A year later, a British team went to Australia and won. Some Australian women burned part of a wicket, put the ashes in a small urn, and presented the urn to the British team captain. The urn was later sent to Lord's, a major cricket ground in London and the headquarters of the M.C.C. It is always kept there, no matter which country wins the Ashes.

Many countries hold one or more championship series. These series include the County Championship in the United Kingdom, the Sheffield Shield in Australia, the Shell Series in New Zealand, the Currie Cup in South Africa, and the Ranji Trophy in India.

Critically reviewed by the International Cricket Council

See also England (picture: Cricket).

Additional resources

Eastaway, Robert. *Cricket Explained.* St. Martin's, 1993.
Rundell, Michael. *The Dictionary of Cricket.* 2nd ed. Oxford, 1995.

Crile, George Washington (1864-1943), an American surgeon, made important contributions to the development of surgery, especially in the areas of shock, hemorrhage, and blood transfusion. He also pioneered the use of blood-pressure measurement in surgery and developed a nerve-block system of anesthesia. His books include *Diseases Peculiar to Civilized Man* (1934); *The Phenomena of Life* (1936); and *Intelligence, Power and Personality* (1941).

Crile was born in Chili, Ohio, on Nov. 11, 1864. He became professor of surgery at Western Reserve University (now Case Western Reserve University) in 1900. He founded the Cleveland Clinic Foundation in 1921.

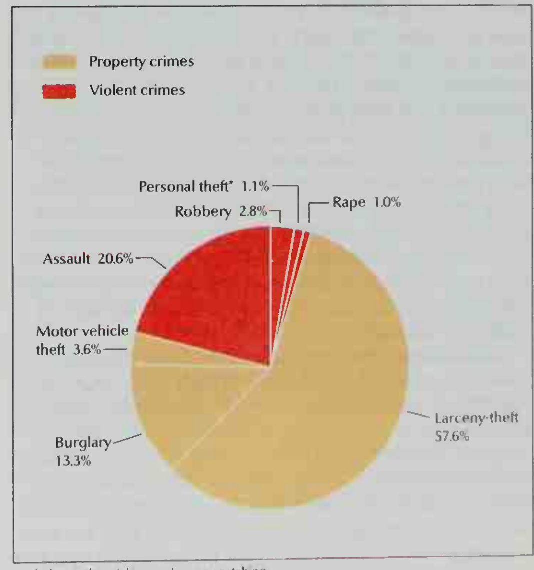
Dale C. Smith

Crime is a term that refers to certain actions that are forbidden by law. Crime includes such conduct as committing murder, stealing a car, resisting arrest, driving while under the influence of alcohol, and possessing or selling illegal drugs. There are many different kinds of crime, which are determined by lawmakers at the federal, state, provincial, and local levels.

The list of acts considered crimes varies from country to country and is constantly changing. For example, people in Western countries are no longer charged with witchcraft, though many were accused of that crime in the 1600's and 1700's. Today, it is a serious crime to pollute the air and water. Pollution caused few problems and received little attention before the 1800's. In England during the 1700's, it was not a crime for people to steal money entrusted to their care by an employer. Today, this type of theft, called *embezzlement,* is a crime.

From a legal standpoint, crimes are violations of *criminal law.* Criminal law deals with actions considered harmful to society. For this reason, a crime is regarded as an offense against the state. *Civil law* involves actions that directly harm individuals, their money, or their property. Some overlapping occurs between the areas of criminal and civil law. For example, murder and rape are committed against individuals, but the law considers

Major crimes in the United States



*Includes pocket picking and purse snatching
Figures are for 1999. Source: U.S. Department of Justice

This chart shows types of major crime as a percentage of all major crimes in the United States, excluding murder. The chart is based on the National Crime Victimization Survey, conducted annually for the Bureau of Justice Statistics by the Census Bureau. Since the survey is based on interviews with victims, it does not include murder. Assault, robbery, rape, and personal theft are *violent crimes.* Larceny-theft, burglary, and motor vehicle theft are *property crimes.*

them crimes because they threaten society. Punishments for violations of civil law involve the payment of money to the injured person. But a person who violates criminal law may be imprisoned, fined, or receive some other punishment, according to the laws of the community in which the crime was committed or a trial was held.

An act is viewed as a crime if enough evidence exists to make a police officer, a prosecutor, or a judge believe that a violation of criminal law has taken place. A person who commits a crime is called a *criminal.* However, in the United States and many other countries, the law does not consider accused people to be criminals unless a judge or jury finds them guilty.

The study of criminal behavior is called *criminology,* and experts in this field are called *criminologists.* Criminologists may try to determine where, when, and why certain types of crime occur. They also seek the relationships between criminals and their victims, as well as the most effective ways to prevent crime. See **Criminology.**

Types of crimes

Crimes may be classified in many ways. For example, they sometimes are grouped according to the seriousness of the offense. Many governments divide crimes into offenses against people, against property, and against public order. Some social scientists classify crimes according to the offenders' motives. Such crimes might include economic crimes, hate crimes, and political crimes. Other important kinds of crime include organized crime, white-collar crime, and computer crime.

Crimes are often divided between acts that most people would consider evil and acts that lawmakers decide should be regulated in the interest of the community. The first group includes such major crimes as arson, assault and battery, burglary, kidnapping, larceny, murder, rape, and robbery. The second group of crimes includes violations of income tax laws, liquor-control regulations, pure food and drug laws, and traffic laws. Crimes in the first group are called *substantive offenses* and usually involve severe punishments. Most of these crimes have long been forbidden by the English *common law.* This body of law is the source of the criminal law codes of the United Kingdom and of many former British colonies, including the United States and Canada (see **Common law**). Offenses in the second group are called *regulatory offenses* and are generally punished by fines or notices to follow the court's orders.

Felonies and misdemeanors. In some countries, crimes are classified according to their seriousness as *felonies* or *misdemeanors.* Such a classification is used, for example, in the United States and in some of the states of Australia. Generally, felonies are more serious than misdemeanors. Under the U.S. federal and state criminal law systems, felonies are punishable by imprisonment for a year or more. In some cases, they are punishable by death. A misdemeanor is punishable by a fine or by imprisonment for less than a year. Most people convicted of felonies in the United States serve their sentence in state or federal prisons. People convicted of misdemeanors serve their sentence in city or county jails or houses of correction.

Although the classification of crimes as felonies or misdemeanors is common, many countries use different methods. The United Kingdom formally abolished the distinction between felonies and misdemeanors in 1967. It now classifies serious crimes as *indictable offenses* and less serious crimes as *summary offenses.* The classification of crimes as serious and less serious is inexact. Not all courts draw the same distinction between the two types. In addition, a serious crime in one country may be considered less serious in another country.

Crimes against people or property. Crimes against people are crimes that physically harm a person or put a person in danger of being harmed. These include violent crimes such as assault and battery, kidnapping, murder, and sexual attacks. Such crimes usually bring severe punishment.

Crimes against property are crimes that might not physically harm a person but might cause the person to lose something of value. Such crimes include arson, burglary, embezzlement, forgery, fraud, larceny, motor vehicle theft, and vandalism. In most cases, these crimes are not punished as severely as crimes against people.

Crimes against public order are offenses that are looked down upon by the general public or a community. These crimes include disorderly conduct, gambling, obscenity, prostitution, and public drunkenness. These offenses generally involve lighter penalties than do crimes against people or property.

Some criminologists question whether certain offenses against public order should be considered crimes. For example, many experts believe that habitual drunkenness is a medical problem and that the offender should be given medical help instead of being put in jail. There is also disagreement about whether certain practices hurt society and should be considered crimes. Such acts include gambling, marijuana use, and prostitution. Some people refer to these activities as *victimless crimes.* They argue that no one who is involved in such activities is an unwilling participant and nobody is directly hurt by them.

Organized crime refers to large-scale criminal activities by groups of gangsters, racketeers, and crime families. Such groups are often called the *crime syndicate* or the *underworld.* Organized crime groups usually provide illegal goods and services to other individuals. Typical activities include gambling, prostitution, the illegal sale of drugs, and *loan-sharking* (lending money at high rates of interest).

Organized crime activities often go unreported and can be difficult to detect. When the crime syndicate invades a legitimate business or labor union, it may use terror, blackmail, and other methods to keep people from going to the police. Even when illegal activities are discovered, prosecutors have difficulty convicting the gangsters because of the lack of reliable witnesses. In addition, the syndicate frequently tries to bribe witnesses or law officers and sometimes succeeds in doing so. The syndicate also furnishes bail money and lawyers for members who are arrested.

White-collar crime originally included only acts committed by business and professional people while earning their living. The term referred to such crimes as stock market swindles and other kinds of fraud. Today, the term covers such acts as cheating in the payment of taxes—which may or may not be done in connection with one's business. It may apply to petty thefts by employees or to million-dollar stock market swindles. It

could also include a service station owner's charging for an automobile repair that was not made, or a physician's charging for services that were not performed.

Many consumer protection laws are aimed at white-collar crime. These laws regulate business and professional activities to protect consumers. During the 1960's and early 1970's, consumer protection became one of the fastest-growing fields of criminal law. In the United States, for example, the federal government developed new rules and penalties. The regulations were intended to control air and water pollution, to prevent fraudulent trade practices, and to alert people seeking loans about actual interest costs. See Consumerism.

Computer crime, sometimes called *cybercrime,* grew rapidly in the 1990's and early 2000's, as the use of computer technology in business created new opportunities for criminal activity. Computer crimes are often difficult to detect but may be easy to accomplish once a criminal learns the code or password that gives access to a computer system.

Computer operators called *hackers* may use their technical knowledge to illegally access companies' computer files. Some hackers damage databases or attempt to steal information or electronic funds. Others may seek access to credit card numbers and other financial information. Many people are concerned about the security of credit card numbers used to make purchases over the Internet. In the late 1990's and early 2000's, many governments passed new laws to address the increased risk of computer crime.

Political crime includes acts of terrorism against the public and assassinations of leading political figures. Political crime became a serious threat throughout the world during the late 1900's and early 2000's. Unlike criminals who seek money or personal gain through crime, most people who commit political crimes do so to make a political statement or to show support for a political cause. Political crimes include airplane hijackings, assassinations, bombings, and the taking of hostages.

Governments around the world take measures to protect civilians and public officials from political crimes. For example, security precautions are taken at airports, embassies, and other potential targets. Governments also maintain specially trained law enforcement or military units to deal with crisis situations. Punishment for these crimes is often severe.

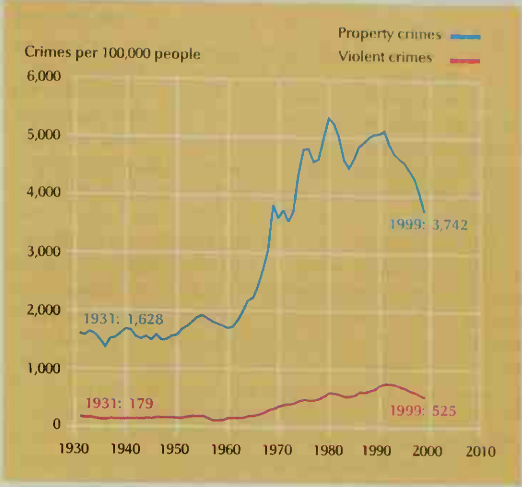
Most frequent arrests in the United States*

Offense charged	Total number of arrests	Arrests per 100,000 people
Drug abuse violations	1,532,200	595
Driving under the influence of alcohol or narcotics	1,511,300	587
Simple assault	1,294,400	503
Larceny-theft	1,189,400	462
Liquor law violations	657,900	256
Drunkenness	656,100	255
Disorderly conduct	633,100	246
Aggravated assault	483,500	185
Fraud	363,800	141
Burglary	296,100	112

*Data are not available for arrests for any traffic violations except driving under the influence. Figures are for 1999.
Sources: Federal Bureau of Investigation; *World Book* estimates

Crime rate in the United States

Rate of crimes reported to law enforcement agencies



Source: Federal Bureau of Investigation.

Hate crime refers to criminal acts committed by an offender because of the victim's ethnic background, race, religion, or sexual orientation. Such crimes may include vandalism, assault and battery, or intimidation through threats or harassment.

Hate crime has long occurred worldwide, but the term did not come into widespread use until the 1980's. In the United States, the first hate crime laws were passed during the 1980's and early 1990's. The Canadian government enacted Canada's first hate crime laws in the 1970's. Most hate crime laws increase the penalty for a crime when the victim is selected because of his or her race, religion, or other characteristics of a particular group.

Treason is a crime that endangers the security of a country or the safety of its leaders. For example, a citizen of a country may commit treason by spying for its enemies in time of war or by attempting to assassinate its ruler. Treason is generally punished by long terms of imprisonment or, in some countries, by execution.

War crime is a military violation of the basic rules of warfare. Since the late 1800's, most nations have signed international treaties establishing rules of wartime conduct. Since World War II (1939-1945), the term *war crime* has been used to refer to any crime, atrocity, or persecution committed during the course of a war. Through the years, many people have been tried for war crimes. War criminals may be tried in the country in which the offenses occurred or by an international body.

The extent of crime

Crime is one of the world's oldest social problems. Throughout history, people have felt threatened by crime and violence. Today, countries vary greatly in their definition of crime and in their tracking of crime statistics. In addition, no country has yet developed completely reliable methods for measuring crime. As a result, the full extent of crime throughout the world cannot be precisely determined.

Crime in the United States. The Federal Bureau of Investigation (FBI) is the primary source of crime information in the United States. The FBI has maintained national crime statistics since 1930. Reporting procedures between 1930 and 1958 gave only an inexact national estimate of crime. Since 1958, improved reporting methods have provided increasingly reliable figures. The FBI receives monthly and annual crime reports from law enforcement agencies throughout the country. It summarizes and publishes this information in semiannual reports and in its annual *Uniform Crime Reports for the United States.*

The FBI's Crime Index measures the amount and distribution of serious crime in the United States. The index covers seven crimes that the FBI considers serious offenses likely to be reported most accurately to the police. Four of these offenses are classified as violent crimes—aggravated assault, forcible rape, murder and nonnegligent manslaughter, and robbery. The other three are crimes against property—burglary, larceny-theft, and motor vehicle theft.

FBI reports show that the total crime rate for serious crimes in the United States tripled between 1960 and 1980. After 1980, the total crime rate leveled off and, in the 1990's and early 2000's, the rate of serious crime decreased. Criminologists and police authorities find it hard to determine how much of the increase between 1960 and 1980 actually occurred and how much resulted from improved crime-reporting procedures. People report millions of serious crimes in the United States each year. Property crimes account for most of these offenses.

Crime around the world. Conditions that affect the amount of crime vary from one country to another. These conditions include the proportion of people living in cities, the proportion of young and old people in the population, and the degree of conflict among various cultural, economic, and racial groups.

Studies have shown that crime rates for both violent crimes and property crimes rose in most countries during the late 1900's. For example, from 1983 to 1997, the property crime rate in England and Wales increased more than 38 percent, and the violent crime rate increased about 64 percent. Many countries experienced decreases in crime rates in the late 1990's and early 2000's. However, many developing nations continue to experience increasing amounts of crime.

Comparisons of the crime rates across multiple nations indicate that increases in crime accompany increases in the rate of social change. Crime rates stay relatively stable in traditional societies where people believe their way of life will continue. Crime rates tend to rise in societies in which there are rapid changes in where people live and what they do for a living. Crime rates are particularly high in industrial nations that have large cities.

Some countries with generally high crime rates—besides the United States—include China, Russia, and South Africa. Countries with relatively low crime rates include Canada, Denmark, Japan, Norway, and Switzerland.

Unreported crime. Statistics about crime are based on complaints to the police, offenses observed by the police, and arrests of suspects. Much crime goes unreported. The United States Census Bureau and the Bureau of Justice Statistics of the U.S. Department of Justice produce an annual survey called *Criminal Victimization in the United States.* This survey reveals that approximately half of all violent crime goes unreported to the police. Many other types of crimes also remain unreported, including offenses against businesses, organizations, and public agencies, and against public order and morality.

The cost of crime to its victims is impossible to determine accurately. Any estimate based on existing data will probably underestimate the cost considerably. For example, a dishonest business scheme may cost consumers or investors millions of dollars, but no records are kept of such losses. Similarly, there is no way to determine how much money organized-crime groups make from gambling, loan-sharking, drug sales, and prostitution.

The cost of crime prevention and control measures is also difficult to determine. Expenditures for law enforcement and criminal justice agencies total many billions of dollars annually. However, these agencies also deal with numerous noncriminal matters, such as traffic control. About 40 percent of police costs can be directly charged to crime control. Similarly, most courts handle civil cases as well as criminal ones.

Causes of crime

People commit crimes for a variety of reasons. For example, many people steal things they could not obtain otherwise. Others, such as drug addicts, steal to get money to buy narcotics or other wants. Some shoplifters steal for excitement, but others do so because they are poor. Many automobile thieves take cars for joy-riding, but others break up the stolen autos and sell the parts. Many embezzlers take money from their employers to meet a personal emergency, intending to return the money.

The motives also vary in crimes of violence. A robber may kill the victim to avoid detection. Some gangsters torture people to obtain money.

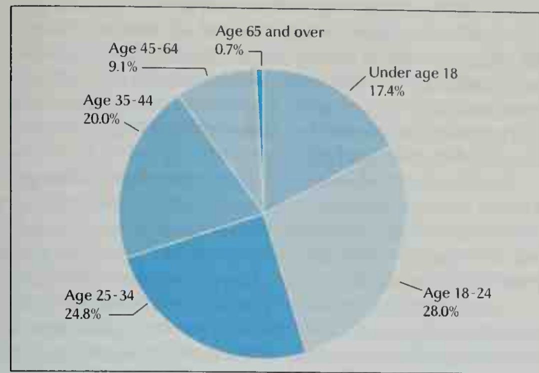
Biological and psychological explanations. Many studies have sought to explain crime. Most of them compare habitual criminals with people who have not been convicted of crimes to try to find important differences between the two groups.

Since the late 1800's, for example, researchers trained in the biological sciences have searched for physical differences. Such studies involve differences in body type, brain waves, and genes. None of these studies has proved that criminals have any physical traits that make them different from other people.

Research by psychiatrists and psychologists stresses personality differences resulting from experiences in childhood or later. This research shows that many people who became criminals were neglected by their parents or were given harsh or uncertain discipline. Such treatment left them insecure and demanding in their relations with others. Their own wants made them ignore the needs or rights of others. But researchers have had difficulty making a direct connection between emotional needs and crime because many people with emotional problems find acceptable ways of solving them.

Social conditions and crime. Sociologists have conducted crime studies that focus on the neighborhood

Arrests by age in the U.S.



Figures are for 1999. Source: Federal Bureau of Investigation.

and community rather than on the individual. Some of these studies deal with how a person becomes committed to a career of crime, and others try to explain differences in crime rates. Many studies focus on crime that is committed by gangs.

The highest crime rates occur in the most deprived sections of large cities. These are the areas where it is most difficult to train children to become law-abiding citizens. Such areas have the highest rate of broken homes. Even in many homes where both parents are present, emotional conflicts and health and financial problems disrupt family life. Slum areas usually have the poorest schools and the highest unemployment rates. These neighborhoods have much rundown, overcrowded housing and poor recreation facilities.

For many young people, the excitement of the streets provides the principal escape from boredom and seemingly unsolvable problems. These streets are also the scene of much vice and crime—gambling, prostitution, narcotics use and sale, public drunkenness, and acts of violence. Law enforcement in the inner city is difficult, partly because there are so many people and relatively few police officers. In addition, many of the residents of these areas fear or distrust the police and refuse to cooperate with them.

Many property crimes are committed by people 18 years old or younger. There are several reasons why young people commit so many of these crimes. Young people have fewer job opportunities. The unskilled jobs available to them seem dull when compared to the quick and exciting returns from theft. Young people are also more willing to risk arrest because they have less stake in things as they are. As people become older and settled in their jobs and families, they acquire a stake in society that they would not care to risk for momentary gain.

In addition, men and women differ in the kinds of crimes they most frequently commit. For example, men are arrested most often for driving under the influence of alcohol and for drug abuse violations. Women are arrested most often for theft.

Many violent crimes are committed by people who are acquainted with their victims. In most murders, for example, the killer and the victim know each other. In numerous cases, because so many murderers know their victims, the police have a relatively easy time identifying the killer. As a result, the arrest and conviction rate for murders is high. Police have a much harder time identifying robbers and burglars, few of whom know their victims.

Crime prevention

For hundreds of years, criminal law has been constructed around the idea that wrongdoers must be punished for their crimes. The most basic argument for punishment is that it preserves law and order and respect for authority. From this point of view, punishment does two things. It upholds the law, and it prevents others from thinking they can get away with doing the same thing. Many criminologists stress the need for improving the performance of criminal justice agencies—the police, the courts, and correctional institutions. For example, they point out that better educated, equipped, and coordinated police forces are more effective in controlling crime.

One of the best ways to reduce crime would be to reform or rehabilitate habitual criminals. The main problem is not the first offender or the petty thief but the repeat offender who commits increasingly serious crimes. But prisons have had little success in rehabilitating inmates. About two-thirds of the people arrested in any year have a previous criminal record.

Rehabilitation of criminals could probably be improved greatly if experts could provide the right kind of program for different types of offenders. Criminals vary widely in the kinds of crimes they commit, their emotional problems, and their social and economic backgrounds. Not all offenders can be helped by the same treatment. Many require the aid of physicians, psychiatrists, or psychologists. Others respond well to educational or vocational training.

Society spends billions of dollars to operate prisons and related institutions yearly, but only a small fraction of this sum goes to provide treatment. Nearly all the funds are used to feed and clothe prisoners and to keep them under control.

In the United States and some other countries, there has been a trend since the late 1970's toward punishment rather than rehabilitation of offenders. Prison sentences are longer. Capital punishment has been used more frequently since the Supreme Court of the United States lifted a death penalty ban in 1976. In some Islamic countries, judges order mutilation or death for a number of offenses.

Most experts agree that crime prevention should aim to prevent people from becoming criminals in the first place. Such a goal probably would benefit from reform programs in urban slums. These programs would include improved housing, schools, and recreation programs and increased job opportunities.

There are many other ways to reduce crime. People can be educated or persuaded to take greater precautions against crime. They can be taught, for example, how to protect their homes from burglary. Automobile thefts would drop sharply if more drivers simply removed their keys and locked their cars when leaving them. Better lighting helps discourage purse-snatchings and other robberies on city streets and in parks. Many experts believe that strict gun-licensing laws greatly reduce crime. Robert W. Taylor

Related articles. See the *World Book* article on Criminology. See also the following articles:

Crimes

Arson	Kidnapping
Assassination	Larceny
Assault and battery	Libel
Bigamy	Lynching
Blackmail	Manslaughter
Breach of the peace	Mayhem
Bribery	Misdemeanor
Burglary	Perjury
Conspiracy	Poaching
Contempt	Polygamy
Counterfeiting	Racketeering
Desertion	Rape
Domestic violence	Riot
Embezzlement	Robbery
Euthanasia	Sabotage
Extortion	Shoplifting
Felony	Slander
Forgery	Smuggling
Fraud	Terrorism
Gambling	Treason
Hate crime	Trespass
Hijacking	Vagrancy
Homicide	Vandalism
Infanticide	War crime
Juvenile delinquency	

Law enforcement procedures

Arrest	Handcuffs
Bail	Indictment
Bertillon system	Inquest
Crime laboratory	Lie detector
Criminal justice system	Police
DNA fingerprinting	Restraining order
False imprisonment	Search warrant
Fingerprinting	Voiceprint
Footprinting	Warrant
Gun control	Wiretapping

Punishment

Capital punishment	Hanging
Chain gang	Lethal injection
Deportation	Parole
Ducking stool	Pillory
Electrocution	Prison
Exile	Probation
Fine	Sentence
Forfeiture	Stocks
Garrote	Torture
Gas chamber	Whipping post
Guillotine	

Other related articles

Amnesty
Bandit
Colonial life in America (Crime and punishment)
Feud
Gang
Internet (Concerns about use of the Internet)
Mafia
Pardon
Reprieve

Additional resources

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Garoogian, David, ed. *Crime in America's Top-Rated Cities.* 3rd ed. Grey Hse., 2000.

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Crime laboratory is a laboratory where experts analyze, identify, and interpret evidence connected with a crime. Glass splinters or a gun found on a suspect may be matched with broken glass or a bullet taken from the scene of a crime. The pattern of bloodstains near a body may indicate how a murder was committed. Other evidence includes documents, drugs and narcotics, fibers, fingerprints, hair, and soil.

The technique of using scientific methods in solving crimes is called *forensic science.* A person who examines evidence in a crime laboratory is known as a *forensic scientist* or a *criminalist.* The word *forensic* comes from a Latin word that means *forum* or *court of law.*

Forensic science includes such specialties as *forensic psychiatry, forensic toxicology,* and *forensic pathology.* A forensic psychiatrist examines persons suspected of a crime to determine if they are legally sane. A forensic toxicologist identifies drugs and poisons in body tissues and determines their effects. A forensic pathologist performs autopsies on victims to learn the cause of death.

How evidence is handled

Criminalists and other investigators protect all evidence according to a security process called a *chain of evidence.* This process involves keeping a record of each person who handles the evidence. The chain begins at the crime scene and ends when the evidence is presented in court. If any evidence is left unguarded, the judge may disallow its admission in court.

There are three steps in handling evidence: (1) collecting the evidence at the crime scene, (2) analyzing the evidence in the laboratory, and (3) presenting the evidence in court.

Collecting the evidence. In most crimes, the evidence is collected either by police officers or by technicians associated with a crime laboratory. But in such serious crimes as bank robbery and murder, criminalists often go to the scene of a crime. They gather the evidence and, if possible, try to reconstruct the crime.

After a crime is discovered, the police *freeze* the scene. They permit nothing to be disturbed and keep unauthorized people out of the area.

Police investigators follow certain procedures to make sure they miss no evidence. First, they photograph the scene from several angles to show the location of the evidence. Then a police artist or an investigator draws a *crime scene sketch,* which records the exact position of each piece of evidence according to precise measurement. The evidence is then collected.

Criminalists and other investigators use several methods to collect evidence. One of the most important methods is used to reveal fingerprints. First, the experts *dust* (brush) a surface with powder. The powder sticks to the oils left on a surface by one or more fingers. The print is photographed and then lifted from the surface with clear adhesive tape. The tape transfers the print to a piece of paper, which forms a permanent record. Fingerprints in blood, grease, or other visible material are photographed directly. See **Fingerprinting**.

To preserve other marks, such as footprints and tire tracks, criminalists first photograph them. Then a cast of the mark is made with plaster of Paris.

Criminalists sometimes use special instruments to collect evidence. For example, a plastic container called

a *vacuum trap* fits on the end of a vacuum cleaner hose and gathers small particles called *trace evidence.* Trace evidence includes fibers, hairs, sand, wood splinters, and particles of glass and paint. Larger evidence, such as bullets and firearms, is also collected. Criminalists label each piece of evidence.

Analyzing the evidence. A crime laboratory uses a number of techniques to identify and analyze evidence. These techniques may involve the use of special instruments or chemical treatments.

Most crime laboratories have several types of microscopes. A *bullet comparison microscope* is used to compare two or more bullets and to examine tool marks and determine their source (see **Ballistics** [Forensic ballistics]). Criminalists identify minerals, drugs, and narcotics with a *polarizing microscope,* which enlarges the crystal forms of each material. A *stereoscopic binocular microscope* helps sort trace evidence and is used to examine handwriting, typewriting, and samples of paint.

Criminalists use chemicals to identify certain damaged evidence. For example, they use acid to restore partially erased serial numbers on stolen property, such as automobiles and bicycles. They also use chemicals to determine the cause of an explosion or a fire. These chemicals detect traces of flammable substances, including gasoline and kerosene, in the burned remains. Chemicals also help identify samples of blood.

Since the mid-1900's, many new instruments have been developed for use in crime laboratories. These instruments include the *spectrophotometer* and the *gas chromatograph.* A spectrophotometer records light and heat rays that the human eye cannot detect. This instrument shows the pattern of the rays when they strike an object. Criminalists can detect forgeries or illegal erasures on documents with a spectrophotometer by comparing the pattern of rays in ink. A gas chromatograph separates the various components of a substance. The amount of each component is then measured. Criminalists use a gas chromatograph to determine the amount of alcohol in a person's blood. See **Chromatography**.

One of the newest techniques of analyzing evidence is called *DNA fingerprinting.* In this method, investigators identify the persons to whom such biological substances as blood, hair, or semen belong by analyzing the genetic material that the substances contain. The genetic material, called *deoxyribonucleic acid* (DNA), is present in most cells. See **DNA fingerprinting**.

Presenting the evidence. Criminalists are responsible for accurately explaining the significance of evidence. They usually present their findings in written reports and may also testify in court. They are called *expert witnesses* because of their training and experience. Courts allow most witnesses to present only facts, but expert witnesses can give opinions based on evidence. They serve chiefly as witnesses for the prosecution.

Careers in forensic science

A person needs at least a B.A. degree in chemistry, criminalistics, or a related science to work in a crime laboratory in the United States. Some colleges and universities offer graduate programs in forensic science that lead to an M.S. or a Ph.D. degree. A student of forensic science takes many chemistry courses and survey courses in such areas as anatomy, botany, geology, physics, and physiology. Most criminalists in the United States work for agencies of the federal, state, or local government. A few are employed as private consultants for individuals, companies, or organizations.

A professional organization called the American Academy of Forensic Science promotes research and training in the forensic sciences. The academy issues a quarterly publication, the *Journal of Forensic Sciences,* which reports on original research conducted in all specialty areas of the profession.

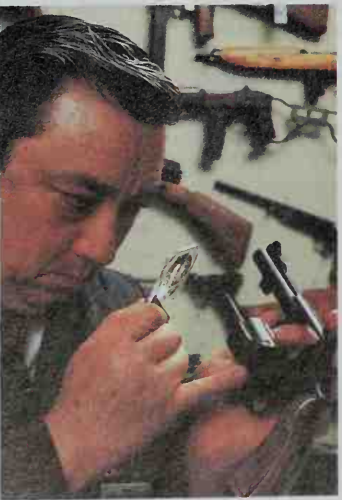
History

One of the first crime laboratories was established in 1910 in Lyon, France, by Edmond Locard, a physician.



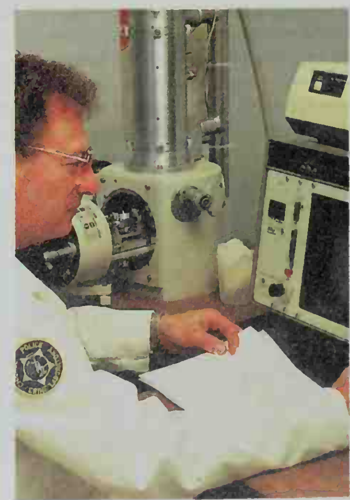
WORLD BOOK photo by Ralph Brunke

A laser beam reveals fingerprints on a handgun. A laboratory technician then photographs the prints.



WORLD BOOK photo by Ralph Brunke

A firearms expert looks for identifying marks on the bullets and weapons connected with a crime.



WORLD BOOK photo by Ralph Brunke

An electron microscope helps in examining *trace evidence,* which consists of hair and other small particles.

Locard helped work out scientific methods to investigate crimes. Alphonse Bertillon, a French statistician, developed a method of identifying persons according to their body measurements. This method, called the *Bertillon system,* was first used in Paris in 1879 and soon spread throughout the world. See **Bertillon system.**

Sir William J. Herschel, a British colonial administrator in India during the late 1800's, was probably the first person to devise a workable method of fingerprint identification. Historians credit Sir Francis Galton, a British scientist, with developing Herschel's methods into a modern system of fingerprint identification in the 1880's. By the late 1910's, fingerprinting had replaced the Bertillon system almost entirely as a more accurate method of identification. In the United States, the Federal Bureau of Investigation (FBI) established a fingerprint file in 1930.

Hans Gross, an Austrian judge, probably invented the word *criminalistics.* In his book *Criminal Investigation* (1893), Gross declared that criminalistics was a science that should use a systematic approach to investigate crimes and analyze evidence.

The first U.S. crime laboratory was set up in Los Angeles in 1923. Today, the nation has about 250 crime laboratories. The FBI crime laboratory, organized in 1932, is one of the finest in the world (see **Federal Bureau of Investigation**). FBI experts examine about 900,000 pieces of evidence yearly. Some crime laboratories examine only one type of evidence. For example, the U.S. Postal Inspector's Department Laboratory examines documents associated with such crimes as mail theft and forgery of money orders. John I. Thornton

See also **DNA fingerprinting; Footprinting; Voiceprint.**

Crimea, *kry MEE uh,* a region of Ukraine, is a peninsula that juts from the southern part of Ukraine into the Black Sea and the Sea of Azov. It covers about 10,400 square miles (27,000 square kilometers) and is joined to the mainland by the narrow Isthmus of Perekop. The population of the Crimea is about 2,309,000. The capital is Simferopol. Other cities include Kerch, Sevastopol, historically important Balaklava, and Yalta, which served as the scene of the historic conference of Allied leaders during World War II (1939-1945).

The Crimea rises gradually from coastal plains to the low Crimean Mountains along the southern coast. The grassy plains furnish pasture for sheep and horses.



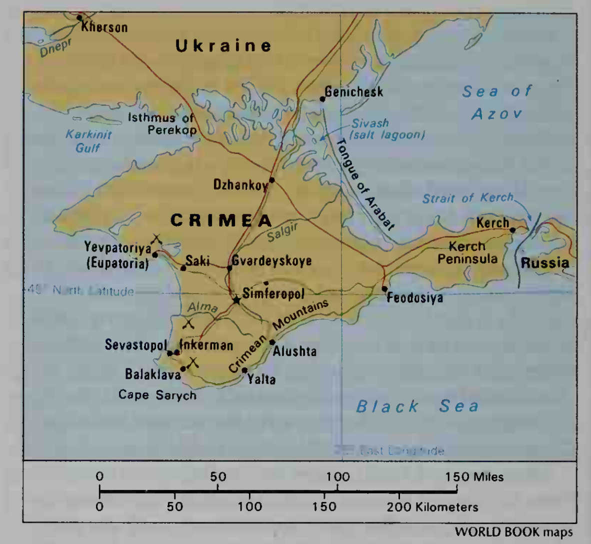
Tass from Sovfoto

The Crimean coast has many beautiful resort towns. Yalta, *above,* lies on the southern coast near the Crimean Mountains.

Crimea







WORLD BOOK maps

Grapes from the vineyards are used to produce wine. Grains flourish in the northern lowlands of the peninsula. Important deposits of iron, marble, and limestone have been found in the Crimea, and salt is dried along the coasts. The chief industries are shipbuilding, mining, and fishing. Resorts and health centers line the coasts.

The Crimea was one of the strongholds of opposition to the Communist government after the Russian Revolution of 1917. In 1921, the Crimea became an autonomous republic within the Russian republic of the Soviet Union.

During World War II, German troops occupied the peninsula from 1941 to 1944. In 1944, Soviet authorities forcibly deported about 250,000 Turkic-speaking people called Tatars from Crimea to Siberia and Central Asia. The Crimean Tatars were falsely accused of collaborating with the Germans. In 1967, these charges were dropped, but the Tatars were prevented from returning to the Crimea in large numbers. The Crimea's autonomous status was removed in 1945, and it became a province of Russia. In 1954, the Soviet Union made the Crimea part of the Soviet republic of Ukraine. In 1991, following an upheaval in the Soviet Union, Ukraine declared itself an independent nation. It became part of the Commonwealth of Independent States, a loose association of former Soviet republics. In 1992, Russia declared the 1954 decision to give Crimea to Ukraine unconstitutional. However, Ukraine opposed this declaration. Jaroslaw Bilocerkowycz

See also **Crimean War; Sevastopol; Tatars; Yalta.**

Crimean War, *kry MEE uhn* (1853-1856), was fought between Russian forces and the allied armies of Britain, France, the Ottoman Empire (now Turkey), and Sardinia. The war's name comes from the Crimean Pen-

insula, an area of present-day Ukraine where much of the fighting took place.

Causes of the war included religious, commercial, and strategic rivalries among Britain, France, and Russia in the Near East and political rivalries between France and Russia in Europe. A chief objection of the allies was Russia's expansion in the Black Sea region. Major battles in the Crimean Peninsula occurred along the River Alma and around the towns of Sevastopol, Balaklava, Inkerman, and Yevpatoriya (also spelled Eupatoria). Russia's lack of supplies, railroads, and reinforcements led to its defeat. The Treaty of Paris, signed on March 30, 1856, ended the war. It forced Russia to give up some territory it had taken from the Ottoman Empire and forbade warships on and fortifications around the Black Sea.

The Crimean War was the first war to be covered by newspaper reporters and photographers at the front. The English poet Lord Tennyson wrote a famous poem, "The Charge of the Light Brigade," about the Battle of Balaklava. The activities of Florence Nightingale, an English nurse, later helped bring about improvements in nursing and hospital care. A. P. Saab

See also **Balaklava, Battle of; Nightingale, Florence.**

Criminal justice system is the system used to enforce the laws established by society. It attempts to protect people from assault, murder, rape, robbery, and other crimes. It also tries to safeguard them from being falsely arrested, imprisoned, or fined.

Every nation has its own system of criminal justice. This article discusses how criminal laws are enforced in the United States. The U.S. system is divided into three areas: (1) the police, (2) the courts, and (3) the correctional system.

The police

The police have the primary responsibility for enforcing the nation's laws. Police officers work to protect the people and property of each community. They also regulate public behavior and act as public servants in ways unrelated to crime. For example, police officers direct traffic, assist motorists, and find lost children.

The main job of a police force is to try to prevent crime. To do this, police officers patrol the streets and parks of a community on foot, in automobiles, on motorcycles, or on horses.

After a crime has been committed, the police question the victim and any witnesses. They also gather such evidence as fingerprints, weapons, and stolen property. If the police have reason to believe that a certain person committed the crime, they arrest him or her. They often apprehend a suspect in the act of committing a crime or soon after the crime takes place. In some cases, police officers are required to obtain a court order called a *warrant* before they arrest a suspect.

Police detectives investigate crimes. These officers work in specialized fields that deal with such crimes as murder, robbery, or the illegal sale of drugs. Various technical units of a police department assist the detectives in investigations. These units examine all evidence that has been gathered. The reports of the detectives and the technical units are later used to support testimony given in court.

The police follow certain procedures when they investigate crimes, and when they arrest suspects and put them in jail. These procedures are governed by strict laws that protect the suspect. For example, the *Miranda rule* requires that before questioning a suspect, the police must inform the individual of his or her rights, including the right to remain silent (see **Miranda v. Arizona**). A person accused of a crime also has the right to have his or her attorney present during questioning.

The courts

Criminal courts decide the legal guilt or innocence of people accused of violating the law. The courts also determine the punishment for those who are convicted.

Pretrial procedures. In most cases, the suspect is brought to court for a hearing within 24 hours after being arrested. At this hearing, called *arraignment,* a judge reads the charges against the defendant. The judge also reads the person his or her rights concerning a fair trial. The most important right of any defendant is the right to be considered innocent until proved guilty "beyond a reasonable doubt." If the defendant pleads guilty to the charges, the judge may sentence the person immediately. If the individual pleads not guilty, the case goes to trial. The judge appoints a defense attorney to handle the defendant's case if the accused person cannot afford a lawyer.

The judge decides whether to keep the defendant in jail until the trial or to release the person on bail. The defendant or another person puts up bail to guarantee that the accused will return to the court to stand trial. A defendant who cannot put up bail must stay in jail until the trial. The courts cannot require bail so high that no one can furnish it. But the judge may deny bail to a person considered likely not to return for trial. Some states also prohibit bail for individuals who are accused of such serious crimes as espionage and murder.

Cases involving less serious crimes, such as disorderly conduct or driving without a license, may be completed in a single court session. In these cases, the judge hears the testimony, decides the guilt or innocence of the defendant, and sentences the guilty.

Cases of murder, kidnapping, or other especially serious crimes may be presented to a *grand jury.* This panel, which consists of 16 to 23 citizens in most states, decides if the evidence against the defendant justifies bringing the case to trial. The purpose of the grand jury is to protect the defendant from being accused of a crime with insufficient evidence.

Many cases are settled by *plea bargaining.* In this procedure, the accused agrees to plead guilty in exchange for being charged with a less serious crime or being promised a shorter prison sentence. About 90 per cent of all defendants plead guilty, most of them through plea bargaining.

The trial. When a criminal case goes to trial, the defendant chooses to have it heard either by a jury or by the judge alone. In most states, a trial jury consists of 12 citizens. However, the juries in some states may have as few as 6 members. The jury or judge hears the evidence for and against the defendant and then reaches a verdict. If the individual is found guilty, the judge pronounces sentence. If the defendant is found not guilty, he or she is released.

In most cases, the judge determines the sentence for a defendant convicted of a crime. The judge imposes

punishment that he or she feels will best serve both the offender and society. Laws may provide a maximum and a minimum sentence according to the crime involved. In some cases, the recommendation of the jury determines the sentence that may be given to the offender.

The judge may put a convicted offender on probation to protect the individual from the harmful effects of being imprisoned with experienced criminals. A lawbreaker who is on probation remains free but must follow certain rules. A probation officer assigned by the court supervises the individual's conduct. A probationer who violates any of the rules of his or her probation may be sent to prison. Some judges require offenders to repay their victims, either with money or by working for them without pay.

The correctional system

The correctional system, often called simply *corrections,* carries out the sentences given by the courts to convicted offenders. This system includes probation, imprisonment, and parole.

Criminologists—and people in general—disagree about the role of the correctional system. Some people believe the purpose of imprisoning offenders is to prevent them from committing more crimes. But this prevention may be only a temporary solution unless a criminal is imprisoned for life. Other individuals think the correctional system should punish convicted offenders so that a sense of justice in society can be maintained.

Many criminologists believe corrections should help criminals become law-abiding citizens. This goal is called *rehabilitation.* Prison programs rehabilitate inmates through vocational training and psychological counseling. These programs also help find jobs for men and women on probation or parole.

Some people feel the correctional system should serve as a *deterrent* to crime—that is, it should discourage people from breaking the law. The term *general deterrence* refers to the process of making an example of lawbreakers in order to dissuade other people from committing crimes. In *individual deterrence,* the experience of punishment convinces an offender to avoid breaking the law again.

Problems in criminal justice

Problems of the police. Traditionally, routine patrolling in police cars has been considered the most effective method of crime prevention. But studies conducted during the 1970's showed that such patrolling may have little effect on crime. Some police departments, in an effort to improve the effectiveness of their patrols, have assigned more officers to walk neighborhood beats. Foot patrols bring police officers into closer contact with a neighborhood and its people than patrolling in cars. This contact enables the police and neighborhood residents to become acquainted more easily and thus work better together in an effort to reduce crime.

Many police officials believe that efforts to convict criminals are hindered by the rules governing the investigation of crimes and the arrest of suspects. However, many other people insist that such rules are necessary to protect the rights of every person. The majority of police officials also are convinced that stricter gun controls would reduce crime (see **Gun control**).

Problems in the courts. A person accused of a crime has the right to be tried as soon as possible after being arrested. But in many cities, an overload of cases has caused serious delays in bringing defendants to trial. Defendants may have to wait more than a year before their cases go to court. Some people feel that inefficiency in the court system causes unnecessary delays. Others believe many cases that go to court could be settled by plea bargaining.

Plea bargaining itself has led to controversy. Critics of this practice believe it jeopardizes the defendant's right to be considered innocent until proved guilty. Others feel that plea bargaining enables some criminals to be punished less severely than they deserve. Supporters of plea bargaining argue that it helps relieve the courts of their overload of cases.

Sentencing may lead to still other problems because different judges often give different sentences to persons convicted of similar crimes. Each judge has his or her own belief about the most appropriate sentence in a given case. Many criminologists feel that differences in sentences imposed for similar crimes are unjust and also add to the problem of unrest in prisons. These experts believe specific, *fixed* sentences for particular crimes would be fairer. According to other criminologists, each defendant has special problems that should affect the sentence imposed by the judge.

Some communities have developed programs of *pretrial intervention.* Such programs offer some defendants counseling, vocational training, and a job before their cases go to trial. Many offenders have been rehabilitated, and the courts have then dismissed the charges against them. Pretrial intervention helps reduce the overload of cases in the courts and enables defendants to avoid prosecution and imprisonment.

Problems in the correctional system. Studies show that the correctional system has had little success. Many convicts return to crime after serving their sentences, and the threat of punishment has not prevented others from breaking the law. Probation and parole officers are overloaded with cases and cannot properly help or supervise all the people assigned to them. Many jails and prisons are severely overcrowded, and riots, beatings, and killings occur frequently. Most of the problems in the correctional system result from a lack of funds and from inadequate planning.

Some prisons allow certain inmates with favorable records to spend periods of time, called *furloughs,* at home or elsewhere with their families. Many criminologists favor *work-release programs,* which allow inmates to hold a job outside the prison and return to custody at night. Both these types of programs help prevent a person's life from being totally disrupted by imprisonment. Some criminologists believe such programs help rehabilitate offenders and so reduce the chance that they will return to crime after being released. Some prisoners are assigned to *halfway houses* or *community correctional centers* before their release. Counselors in these institutions help inmates readjust to life in the community. James O. Finckenauer

Related articles in *World Book* include:

Arrest
Bail
Court
Crime
Criminology
Due process of law
Escobedo v. Illinois
Evidence

Indictment
Judge
Jury
Juvenile delinquency
Law enforcement
Pardon
Parole
Plea bargaining
Police
Prison
Probation
Reformatory
Sentence
Supreme Court of the United States (Civil rights)
Trial
Warrant

Criminology is the scientific study of crime, criminals, criminal behavior, and the criminal justice system. Criminologists conduct research that examines factors related to crime. They also study individuals to learn how and why people become criminals. Most research in criminology involves such related fields as sociology, psychology, and psychiatry.

Criminology helps provide an understanding of the nature of crime. The results of criminological research help guide community leaders and law enforcement officials in crime prevention. Criminologists also help determine the best methods of treating offenders.

In the United States, criminology is taught chiefly in departments of criminology and criminal justice of colleges and universities. This instruction emphasizes social and environmental causes of crime. In Europe, criminology is generally taught in law or medical schools. European schools have traditionally emphasized the relationship of biological characteristics to criminal behavior. But today, social science research plays an increasingly important role in European criminology.

What criminologists study

Criminologists devote much research to personal and other factors that may cause crime. Most criminological research examines environmental conditions associated with crimes. Some studies concentrate on the connection between crime and such biological factors as brain structure and chemical imbalances. Others emphasize the role that people's emotions and motives play in criminal behavior.

Sociological theories and methods serve as the basis for most studies of environmental causes of crime. Many criminologists investigate the relationship between crime and other social problems, including poverty, poor housing, and overcrowding. Some study the ways in which individuals learn criminal behavior through association with people—including criminals—who have little regard for the law.

Criminologists also study *penology,* the science of the punishment and treatment of offenders. During the early 1900's, penologists began to stress *rehabilitation,* the treatment of criminals with the goal of restoring them to useful lives. However, studies during the 1970's showed that rehabilitation had little success. Today, criminologists recommend making punishment more certain than ever, bringing people to trial quickly, imposing fair and uniform sentences, and providing prisons that are more humane.

Most criminologists do not consider criminal investigation techniques as a part of criminology. People who analyze evidence and do other investigative police work are called *criminalists.* See Crime laboratory.

Methods of criminology

Criminologists use a wide variety of research techniques. The two most important methods of criminology research are *statistical studies* and *case studies.*

Statistical studies help criminologists to formulate and test their theories. These experts use statistics to study the crime rate and the characteristics of criminals.

Crime statistics help criminologists find relationships between crime rates and certain physical or social conditions. For example, such studies may show that the crime rate increases when poverty and unemployment rise. Criminologists generally use statistics compiled by government agencies.

Criminologists also use statistics to learn about personality traits or social conditions that are more common among criminals than other people. Researchers usually compare a group of criminals with a group of noncriminals who are similar to the lawbreakers in most ways. Differences between the two groups can be measured in this manner. Any personality trait or social condition that occurs more frequently among criminals may be one of many causes of criminal behavior.

Case studies. In a case study, a criminologist examines all the personality traits and social conditions that affect one criminal. The researcher studies the person's family history, environment, physical condition, psychological state, and many other characteristics. All these details help determine how certain conditions produce criminal behavior in an individual. Some case studies are conducted on certain groups of criminals, such as rapists or juvenile gangs. A criminologist may use the results of a case history to work out a theory about the development of criminal behavior.

History

Criminology began to develop as a distinct area of study during the 1700's. In 1764, an Italian economist named Cesare Bonesana, Marchese di Beccaria, wrote *On Crimes and Punishments.* This book became the foundation of the *classical school* of criminology.

Beccaria and his followers protested the severe punishments that were common for criminals at that time. They argued that the only purpose of punishment should be to prevent future crime. Beccaria assumed that criminals had free will and that pleasure and pain



WORLD BOOK photo by Ralph Brunke

A criminologist interviews a criminal as part of a case study. Interviews help criminologists learn about personality traits and social conditions that may cause criminal behavior.

determined their actions. He believed crime could be prevented by the certainty and speed of punishment, rather than its severity. According to Beccaria, everyone who violated a specific law should receive the same punishment, regardless of age, sex, wealth, or social position. In modified form, the principles of the classical school are the basis of criminal law today in the United States, Canada, and many other nations.

The *positive school* of criminology, also known as the *Italian school,* developed during the late 1800's. In general, this school shifted the emphasis of criminology from crime itself to the study of criminals and the possible causes of their actions. The positivists believed criminal behavior resulted from conditions beyond the criminal's control. Cesare Lombroso, an Italian physician, was the most important leader of the positive school. He studied many criminals and concluded that certain physical traits made them different from other people. His ideas have been proved false, but his scientific approach to crime laid the basis for modern criminology.

During the 1900's, criminologists have proposed a wide variety of theories about crime. Edwin H. Sutherland, an American criminologist, developed the *theory of differential association.* It states that all criminal behavior is learned through association with criminals or people with unfavorable attitudes toward the law. Other criminologists believe the structure of society leads some people to choose criminal methods to achieve such socially approved goals as wealth and status. Still others argue that society produces crime, and so crime can be reduced or eliminated only by changing the organization of society.

Careers

Most criminologists have university training in criminal justice, criminology, sociology, psychology, psychiatry, or related areas. Requirements vary for a career, but most criminologists have a master's or doctor's degree. Many of these experts conduct research and teach criminology at universities and colleges.

Many social workers are employed in the general area of criminology. Parole and probation officers must have a knowledge of criminology. Personnel trained in criminology also work in crime prevention programs and in the treatment of offenders. Lawyers, judges, and prison superintendents also should have some knowledge of criminology.

In the United States, the major professional organization for criminologists is the American Society of Criminology, which was founded in 1941. The society issues a quarterly publication called *Criminology: An Interdisciplinary Journal.* Charles F. Wellford

See also Crime; **Juvenile delinquency; Prison.**

Criticism is the analysis and judgment of works of art. It tries to interpret and to evaluate such works and to examine the principles by which they may be understood. Criticism attempts to promote high standards among artists and to encourage the appreciation of art. It also helps society remain aware of the value of both past and present works of art.

Criticism plays an important part in every art form. This article emphasizes literary criticism.

Kinds of literary criticism. Criticism can be divided into four basic types. They differ according to which aspect of art the critic chooses to emphasize. *Formal criticism* examines the forms or structures of works of art. It may also compare a work with others of its *genre* (kind), such as other tragic plays or other sonnets. Formal criticism is sometimes *intrinsic*—that is, it may seek to treat each work of art as complete in itself. *Rhetorical criticism* analyzes the means by which a work of art affects an audience. It focuses on style and on general principles of psychology. *Expressive criticism* regards works as expressing the ideas or feelings of the artist. It examines the artist's background and conscious or unconscious motives. *Mimetic criticism* views art as an imitation of the world. It analyzes the ways that artists show reality, and their thoughts about it.

The four types of criticism can also be combined. For example, a critic who looks at the form of a work might also study the way this form affects an audience.

History of literary criticism. The ancient Greek philosopher Plato was the first known literary critic. He accused poetry of imitating the mere appearance of things. Aristotle, his pupil, defended epic poetry and tragic drama. In his *Poetics,* Aristotle said that poetry is an instructive imitation, not of things but of actions. Other essays on criticism tended to be rhetorical handbooks that taught writers how to achieve certain effects. They included *Art of Poetry* by the Roman poet Horace and *On the Sublime* by the Greek writer Longinus.

During the late 1500's, such critics as the English poet Sir Philip Sidney praised literature as the image of an ideal world. During the 1600's and 1700's, critics turned their attention to defining the rules by which they thought works should be written and judged. The three most important English critics during this period were John Dryden, Samuel Johnson, and Alexander Pope.

At the end of the 1700's, critics in Germany and England began to regard literature as an expression of the author's imagination. These critics, called romantics, compared the forms of poems to those of living creatures, each with its own organic unity. Johann Wolfgang von Goethe, Friedrich Schiller, and the brothers August and Friedrich Schlegel were important German romantic critics. The greatest of the English romantic critics were Samuel Taylor Coleridge and William Hazlitt.

In the mid-1800's, critics stressed the relation between art and society. The English writer Matthew Arnold thought poetry should be "a criticism of life," which could help people attain a more accurate spiritual vision of the world, and correct the illusions of political propaganda. The American critics of the 1800's also related art to society. But they insisted that American experience was different from that of Europe and therefore required a different sort of art. Ralph Waldo Emerson, an influential American writer, called for a new, democratic breed of author who would look to the future rather than the past.

In the late 1800's and early 1900's, the novelist Henry James attempted a balance between American and European ideas of culture. James also wrote many essays on the craft of fiction. Later, such American critics as Edmund Wilson and Lionel Trilling continued the effort to relate American culture to its art.

In the early 1900's, the poet T. S. Eliot argued for a criticism that would be the servant of poetry, not of society. I. A. Richards, an English critic, developed methods of

close reading. He asked readers to pay attention to the exact meaning of the text, not to impose their own ideas on it. In the mid-1900's, a movement called the *New Criticism* was popular in America. Such New Critics as Cleanth Brooks and John Crowe Ransom analyzed a work of literature as a self-contained whole, without reference to its historical period, the author's life, or other external influences.

Beginning in the 1950's, many critics turned from interpretative criticism to issues of theory. *Semiotics* approaches literature as a system of symbols that can be broken down like a language into parts for analysis. It is derived from the language theories of the American philosopher Charles Sanders Peirce and the Swiss linguist Ferdinand de Saussure. *Deconstructionism* is a theory based on the work of French philosopher Jacques Derrida. It states that every text dissolves into contradictions under close examination.

In the *reader-response theory,* critics attempt to understand how the audience plays a part in shaping the experience of literature. Some reader-response theorists stress how the psychological makeup of people causes them to read a work in different ways. *Feminist literary criticism* looks at the way the gender of the writer or the reader affects the writing or reading experience. Some feminist critics suggest that women's imagination and approach to language differ from men's. *New historicism,* based on the theories of French philosopher Michel Foucault and American anthropologist Clifford Geertz, emphasizes the historical analysis of literature. It insists that history, like literature, is not a matter of "hard facts," but of texts that need to be interpreted to be understood. David H. Richter

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Crittenden Compromise was a proposal submitted to the United States Senate in 1860 by Senator John Crittenden of Kentucky in an effort to keep the Southern States from leaving the Union. The Compromise proposed six amendments to the U.S. Constitution. Among other things it provided that slavery be protected south of 36° 30', and prohibited north of that line. The Compromise also denied the right of Congress to abolish slavery "in places under its exclusive jurisdiction." It protected the interstate slave trade, and it provided for compensation by the United States government to the owners of slaves who had been helped to escape. Defeat of the Compromise was due partly to President-elect Abraham Lincoln's opposition to any extension of slavery. Robert F. Dalzell, Jr.



Logan Museum of Anthropology, Beloit College (Randall White)



Randall White

Remains of Cro-Magnon culture include weapons and artwork. The Cro-Magnon spearheads shown here were made from reindeer antlers about 33,000 years ago. The engraving of a trotting horse, also shown here, was cut into a limestone slab by a Cro-Magnon artist about 11,000 years ago. Both the engraving and the spearheads were found in southwestern France.

Cro-Magnons, *kroh MAG nahnz,* were prehistoric human beings who lived in Europe, Asia, and North Africa from about 40,000 to 10,000 years ago. The name comes from the Cro-Magnon cave in Les Eyzies, in southwestern France. The first Cro-Magnon skeletons were discovered there in 1868, and more than 100 Cro-Magnon skeletons have since been found. The skeletons indicate that these people were strong and had a height of more than 5 $\frac{1}{2}$ feet (170 centimeters). The bone structure of the Cro-Magnons was similar to that of modern people. Scientists believe that the Cro-Magnons were an early form of modern human being.

Cro-Magnons hunted game on the cold, grassy plains of Europe. Ice sheets covered much of Europe when the Cro-Magnons lived there. Cro-Magnon hunters made weapons with tools of bone and stone. They also used such tools to scrape skins and to sew hides for clothing and shelter. The tools varied, and the people improved them through the centuries. Most Cro-Magnons lived in shelters built in the open, but some made shelters in caves. Some family groups may have wandered long distances. They probably exchanged such items as special rocks for toolmaking with other groups.

Some Cro-Magnons produced beautiful cave paintings. They painted animal pictures in caves in southwestern France and northern Spain. They also made bone carvings and modeled in clay. Alan E. Mann

Croatan Indians. See Lumbee Indians.

Croatia, *kroh AY shuh,* is a country in southeastern Europe. It is bordered on the south by Bosnia-Herzegovina, on the west by the Adriatic Sea, on the north by Slovenia and Hungary, and on the east by Serbia, which is a republic of Yugoslavia.

Zagreb is Croatia's capital and largest city and the center of the country's cultural and political life. Other important towns in Croatia include Dubrovnik, Osijek, Rijeka, and Split.

Most of the people are Croats (pronounced *KROH ats).* Croatia's population also includes a number of Bosnians and Serbs.

In 1918, Croatia became part of the Kingdom of the Serbs, Croats, and Slovenes, later renamed Yugoslavia. In 1946, Yugoslavia became a federal state consisting of six republics, one of which was Croatia.

From 1945 to 1990, Communists held a monopoly on power in all of Yugoslavia. During the 1960's, some Croats began to call for independence for Croatia. During the 1980's, the demands grew. In 1990, Croatia held its first multiparty elections, and non-Communists won a majority of seats in the legislature. In 1991, Croatia declared its independence. War then broke out in Croatia between Croats and Serbs. A cease-fire in early 1992 ended most of the fighting. However, some fighting continued. In late 1995, the government of Croatia and the leaders of the Croatian Serbs made an agreement to end the war.

Government. Croatia adopted its first democratic constitution in December 1990, while it was still a Yugoslav republic. The Constitution has been amended several times since then. It guarantees freedom of speech, assembly, press, and religion. It also promises the right to form political parties and the right of minority groups to cultural independence.

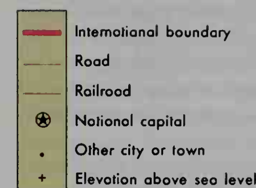
The voters elect the president to a five-year term. The president may be reelected only once. A 151-member parliament makes the laws of the country. The people elect the members of parliament to four-year terms.

The leading political parties in Croatia include the Social Liberal Party, the Social Democratic Party (formerly the Communist Party), and the Croatian Democratic Union. Other parties include the Croatian Democratic Party and the Party of Rights.

Facts in brief

Capital: Zagreb.
Official language: Croatian.
Official name: Republika Hrvatska (Republic of Croatia).
Area: 21,829 mi^2 (56,538 km^2). *Greatest distances*—north-south, 290 mi (465 km); east-west, 290 mi (465 km).
Elevation: *Highest*—Mount Troglav, 6,276 ft (1,913 m) above sea level. *Lowest*—sea level along the coast.
Population: *Estimated 2002 population*—4,460,000; density, 204 per mi^2 (79 per km^2); distribution, 54 percent urban, 46 percent rural. *1991 census*—4,784,265.
Chief products: *Agriculture*—apples, cattle, cherries, corn, grapes, olives, pears, pigs, plums, potatoes, poultry, sheep, soybeans, sugar beets, tobacco, wheat. *Manufacturing*—chemicals, petroleum, ships, textiles. *Mining*—bauxite, coal.
Flag: The flag has horizontal stripes of red, white, and blue. The coat of arms is in the center. See Flag (picture: Flags of Europe).
National anthem: "Lijepa naša domovino" ("Our Beautiful Homeland").
Money: *Basic unit*—kuna. One hundred lipe equal one kuna.

Croatia







WORLD BOOK maps

The Supreme Court is Croatia's highest court. A special committee chosen by parliament appoints members of this court to life terms. Croatia also has a constitutional court. The parliament names the 11 judges of this court to eight-year terms.

People. Croats make up most of the population. Croatia also has a small percentage of Bosnians and Serbs. The Bosnians sought refuge in Croatia in the first half of the 1990's, when a war was being fought in neighboring Bosnia-Herzegovina.

The Croatian and Serbian languages are so similar that experts consider them two forms of a single language, often called Serbo-Croatian. Croatian is written in the Roman alphabet, and Serbian usually employs the Cyrillic alphabet, the system of writing also used in Russian. In the early 1990's, during the war, Croats began a campaign to further distinguish Croatian from Serbian. They sought to restore ancient Croatian words and to invent new words with Croatian roots. Many of the Croats, especially those in the major cities or along the Adriatic coast, speak either German or English in addition to Croatian.

Most Croats are Roman Catholics. The traditional religion of the Serbs is the Serbian Orthodox faith. Bosnian



Zagreb is Croatia's capital and largest city. People shop for fruits and vegetables at an outdoor Zagreb market, *shown here.* The St. Stephen's Cathedral rises in the background.

Alexander Boulat, Sipa Press

Muslims have traditionally practiced the Islamic faith.

Most of Croatia's rural families live in wooden houses with steep roofs. Many suburban residents have homes in modern high-rise apartment buildings. City dwellers often live in older houses or apartment buildings.

Croats value close family ties. Traditionally, the father holds the most authority in the family. Since the mid-1970's, however, a women's rights movement has grown in Croatia, especially in Zagreb. The movement has challenged the traditional ideas about authority in the family and called for women to have economic, political, and social equality with men.

Croatian cooking is similar to that of other central European countries. One of Croatia's best-loved dishes is *Zagreb veal cutlet,* breaded veal slices. Another traditional dish is *gibanica* (pronounced *GIHB bah niht sa*), a layered cheese pastry that may be eaten alone or with a meat dish. Croatia also makes some excellent wines.

Almost all adults in Croatia can read and write. Children are required to attend school between the ages of 6 and 14. Croatia has universities in Rijeka, Split, and Zagreb and many other institutions of higher education.

Croatia has a lively cultural tradition. During the early 1900's, Croatian sculptor Ivan Meštrović became famous for his highly patriotic and religious works. Traditional dances of the Croats include the *kolo,* a fast-paced dance performed in a circle. Jazz festivals attract large audiences in Croatia, and classical music is also popular. Rock music, too, is extremely popular and has served as a means of expressing strong political views. During the 1970's and 1980's, many Croatian rock groups performed songs that criticized the Communist system or its policies. Since that time, many rock groups have promoted Croatian pride and independence.

Land and climate. Croatia consists of two land regions: (1) Dalmatia and (2) the Pannonian Plains. Dalmatia, a coastal region between the Adriatic Sea and Bosnia-Herzegovina, has rocky cliffs and little fertile soil. The fertile Pannonian Plains, which include the historic region of Slavonia, border on Hungary. The Dinaric Alps extend through the center of Croatia. Croatia's two main rivers, the Drava and the Sava, flow into the Danube, one of the most important waterways in Europe.

Dalmatia has a mild climate. In winter, the temperature rarely falls below freezing. However, a cold, gusty wind called a *bora* sometimes blows down from the mountains into the northern areas in autumn and winter. Summers are sunny, hot, and dry.

The Pannonian Plains have cold winters with a freezing wind called a *košava.* Summers are dry and hot. Temperatures often rise to about 100 °F (38 °C). Heavy rains in spring and autumn frequently cause floods along the Danube River and its tributaries.

Economy. Zagreb is Croatia's leading manufacturing center. The country's major products include chemicals, petroleum, ships, and textiles. Croatia is also an important producer of cement and steel. The country's most valuable mineral resources are bauxite and coal.

Croatia's chief crops are corn, potatoes, soybeans, sugar beets, tobacco, and wheat. The crops also include such fruits as apples, cherries, grapes, olives, pears, and plums. Farmers raise cattle, pigs, poultry, and sheep.

Tourism contributes to Croatia's economy. Resorts along the Adriatic coast and on the islands of Brač, Hvar, and Krk are popular tourist sites. The historic walled city of Dubrovnik draws sightseers.

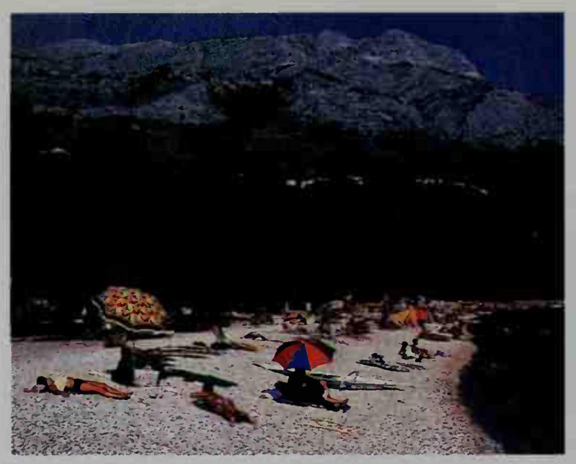
Croatia's major trading partners are Austria, Germany, and Italy. These countries and the United Kingdom provide most of the tourist traffic to Croatia.

Croatia has a good system of roads and railroads. But during the fighting in the early 1990's, Serbian forces destroyed bridges over the Sava River. They also occupied some roads leading to Bosnia-Herzegovina and prevented use of some rail lines. In 1995, after a peace agreement ended the war, Croatia began rebuilding bridges and restoring use of roads and rail lines.

Croatia has airports in Pula, Rijeka, Split, and Zagreb. The country's major seaports are Dubrovnik, Rijeka, Šibenik, and Split.

The leading daily newspapers in Croatia are *Večernji list* and *Vjesnik* of Zagreb and *Slobodna Dalmacija* of Split. The weekly newspaper *Nacional* and the weekly magazines *Globus* and *Obzor* are also popular.

History. Slavic tribes began to settle in what is now



© Jonathan Blair, Woodfin Camp, Inc.

Croatia's dramatic coastline along the Adriatic Sea has traditionally drawn many tourists. Vacationers swim and sunbathe at a beach on the Makarska Riviera, near Split, *shown here.*

Croatia during the A.D. 600's. In 803, Croatian tribes accepted the rule of Charlemagne, a Germanic ruler who united much of western Europe to form a great empire. The Croats soon converted to Christianity. Croatia was an independent kingdom in the 900's and 1000's.

In 1102, Kálmán, the king of Hungary, also became king of Croatia, thus creating a political union between Croatia and Hungary that lasted for more than 800 years. Despite this union, the Croats always kept their own parliament, called the *Sabor.*

In 1526, the Ottoman Empire, based in present-day Turkey, defeated a Hungarian army in the Battle of Mohács. As a result, much of both Hungary and Croatia came under Ottoman rule. The Habsburgs, an Austrian royal family, gained control of the rest of Croatia at about the same time. Most of Croatia remained under Ottoman rule until it was transferred to the Habsburgs by the Treaty of Karlowitz in 1699.

In 1809, Croatia became part of the Illyrian Provinces of Emperor Napoleon I of France. In 1815, the Habsburgs once again took over Croatia. In 1867, the Habsburg Empire was restructured as the *Dual Monarchy* of Austria-Hungary. Austria and Hungary had equal political status within the restructured monarchy. Hungary took over Croatia, except for Dalmatia, which came under Austrian rule. The following year, Croatia signed the *Nagodba* (agreement) with Hungary. The agreement guaranteed Croatia some of its historic rights.

Austria-Hungary fought on the side of the defeated Central Powers in World War I (1914-1918). After the war, it was broken into a number of pieces. In 1918, Croatia became part of a new state called the Kingdom of the Serbs, Croats, and Slovenes. The Croats hoped they would have full equality and regional *autonomy* (self-rule) within the kingdom. Instead, the Serbs used their greater military power to enforce centralized rule from Belgrade, the Serbian capital. In addition, taxation, military promotions, and banking policies discriminated against the Croats in favor of the Serbs.

In 1921, the Serbs passed a new constitution despite objections by the Croats. The Croatian Peasant Party—then the largest political party in Croatia—boycotted sessions of the legislative assembly held to draft the Constitution. The party continued its boycott of the assembly for several years. King Alexander I of Serbia took the throne of the combined kingdom under the Constitution. In 1929, the king changed the name of the kingdom to Yugoslavia and began to rule as dictator. He was assassinated in 1934 by a Macedonian from Bulgaria who was supported by Croatian revolutionaries. Hostility between the Croats and Serbs continued.

In 1939, an agreement granted Croatia much control over its own affairs and those of Bosnia-Herzegovina. World War II broke out later that year. In 1940, Serbian military officers opposed to the agreement seized control of the government, and the agreement ended.

In 1941, during the war, the Axis powers—led by Germany and Italy—invaded and occupied Yugoslavia. Croatia was proclaimed an independent state, but it was actually controlled by the Axis. Croatia was forced to turn over much of its coastal territory to Italy but was given control of Bosnia-Herzegovina.

Communist rule. After the war ended with the defeat of the Axis in 1945, Communists came to power in Yugoslavia. Josip Broz Tito, secretary-general of the Communist Party, became the prime minister and later became president. Under a constitution passed in 1946, Yugoslavia was organized as a federal state—that is, one in which the powers of government were shared between a central government and republics. Croatia then became one of Yugoslavia's six republics, as did Bosnia-Herzegovina. In 1947, most of Istria, which had belonged to Italy, became part of Croatia. In 1963, a new constitution was enacted. It gave the republics some control over their own affairs. After its passage, Croats began to press for greater independence.

Between 1967 and 1971, Croatian politics became increasingly liberal. Many Croatian leaders openly resented Serbia's influence in the federal government and demanded more control over Croatian affairs. In 1971, Tito forced many Croatian liberals to leave their posts, including Savka Dabčević-Kučar and Miko Tripalo, Croatia's leading political figures. From 1971 to the death of Tito in 1980, Croatia was ruled by conservatives who kept liberal economic reforms, but enforced a stricter line in political and cultural spheres.

After Tito's death, the federation that made up Yugoslavia began to unravel. Many Croats called for complete independence from Yugoslavia. They complained that the federal government took too much of Croatia's income and that Serbia sought to control Croatia and the other republics.

Croatia's relations with Serbia worsened dramatically in the late 1980's with the rise to power of Serbian leader Slobodan Milošević. Milošević, a strong supporter of Serbian unity and the expansion of Serbia's borders, began to rally the Serbian minority in Croatia against the Croatian government.

In 1990, the Communist Party gave up its monopoly on power in Yugoslavia. Croatia held multiparty elections, and non-Communists won control of the legislature. Croatia abandoned Communism and began to establish a free enterprise system, in which businesses could operate without government control.

Independence. Croatia and another Yugoslav republic, Slovenia, sought political reforms that would have

transformed Yugoslavia into a union of independent states. Serbia and Montenegro, on the other hand, aimed to make Yugoslavia into a centralized state. After negotiations failed, Croatia and Slovenia each declared independence in June 1991.

In 1990, Milošević had begun smuggling large quantities of arms and other military equipment to Serbs living in Croatia. In 1991, after Croatia declared its independence, war broke out between Serbs and Croats in Croatia. The Yugoslav National Army fought alongside the Serbs against the Croats. Croatia lost more than 30 percent of its territory to the Serbs within a few months. The war also destroyed about 40 percent of Croatian industry, as well as many historic buildings and monuments. About 10,000 people were killed.

In early 1992, the Yugoslav National Army and the Croatian forces signed a cease-fire agreement. The United Nations sent a peacekeeping force to Croatia, but scattered fighting continued. In April 1992, Serbia and Montenegro formed a new state of Yugoslavia, in effect accepting Croatia's independence. In mid-1995, Croatian forces began taking back territory seized by the Serbs. In late 1995, the Croatian government and leaders of the Croatian Serbs made peace. In January 1998, the remaining land that had been seized by Croatian Serbs was reunited with Croatia. Elections in 2000 brought the Social Democrats to power. Sabrina P. Ramet

See also **Meštrović, Ivan; Split; Yugoslavia** (History); **Zagreb.**

Croatoan. See Lost Colony.

Croce, *KRAW cheh,* **Benedetto,** *beh neh DEHT taw* (1866-1952), was probably the most distinguished Italian philosopher of the 1900's. He believed there are two kinds of knowledge: that which comes from understanding and that obtained from the imagination. For Croce, imagination rules art. He believed that art does not attempt to classify objects as a science does, but only feels and presents them.

Croce helped revive interest in the work of the Italian thinker Giambiattista Vico and influenced the reassessment of the ideas of the German philosopher G. W. F. Hegel. Croce founded and edited *La Critica,* a journal of literature, philosophy, and history. Croce's books include *Aesthetic* (1902), *Philosophy of the Practical* (1908), *Logic* (1909), and *History as the Story of Liberty* (1938).

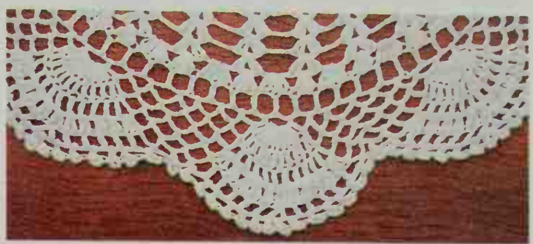
Croce was born in Pescasseroli, near Pescara. He was appointed a senator in 1910. Croce helped reform Italian schools in the 1920's. He was an opponent of the Fascist government of Benito Mussolini and was a leader in liberal intellectual circles in Italy. Karl Ameriks

Crochet, *kroh SHAY,* is a type of needlework that uses a hooked needle to pull a thread into interlocking looped stitches to form a fabric. People commonly use crochet to create baby clothes, sweaters, hats, mittens, purses, shawls, comforters, and afghans. Artists create flat and three-dimensional artworks in crochet.

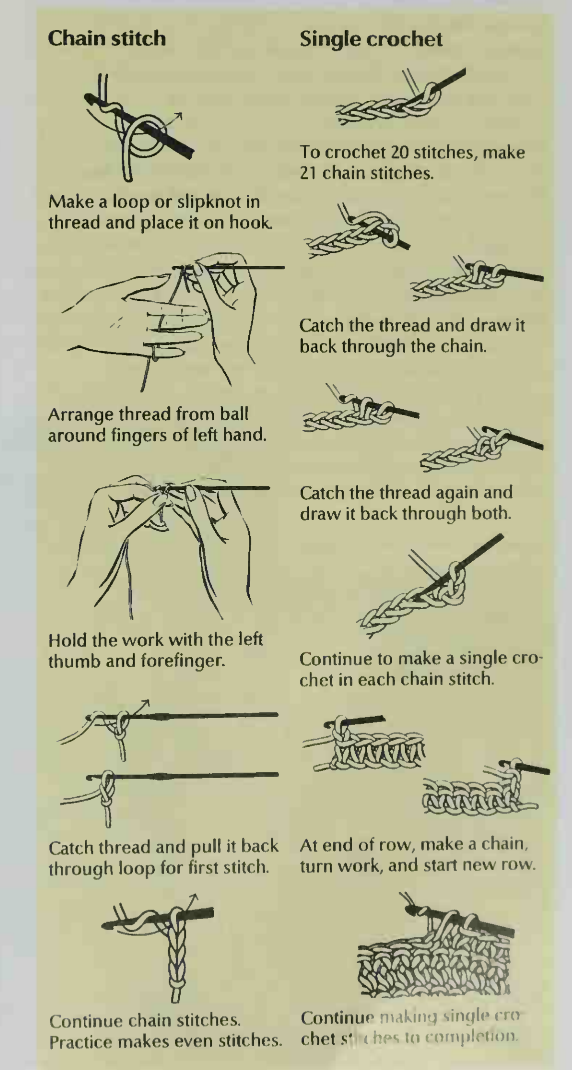
People first crocheted with wool yarn, or fine cotton, silk, or linen thread. However, almost any fiber may be crocheted. Today, people crochet items made of light and heavy cotton, acrylic and wool yarns, and plain and metallic threads. Crocheted material may have a smooth, shiny, fleecy, or nubby texture. Different colors and threads may be combined for interesting surfaces. People may also work in beads, sequins, and baubles.

Crochet hook sizes are generally chosen to match the thread thickness. Thicker yarns need thicker hooks. The hooks may be made of metal, wood, plastic, or bone.

There are many different crochet stitches. The basic chain stitch begins with a loop. A thread is drawn through the loop to form another loop. The first row


WORLD BOOK photo by Ralph Brunke

Crochet lace is made with yarn or thread and a crochet hook. Crochet stitches can be combined to produce a great variety of patterns. The illustrations below show how to make two stitches.



builds up in this way until a length of stitches forms and becomes the fabric edge. The final fabric results by working loops into rows back and forth from the beginning edge row. The middle finger and thumb of one hand hold the thread so it can be picked up by the hook held in the other hand. Other stitches include the *single, double, slip, loop, bullion, picot,* and *cross treble.* These stitches are all variations of the chain procedure.

Crocheting is a popular hobby because the materials are usually inexpensive and the work proceeds quickly. The projects are easy to carry, which enables people to work on them in spare moments. Many classes, magazines, exhibits, and Internet discussion groups are dedicated to the subject of crochet.

The word *crochet* means *hook* in French. An early form of crochet was used in France and other western European countries in the late 1700's. However, crocheting as we know it today did not become widely popular until the 1840's. At that time, books and women's magazines contained printed patterns for crocheted doilies, tablecloths, pillow covers, and edgings. Since the 1960's, people have explored the crochet technique and applied it to wall-hangings, window treatments, sculpture, and wearable art. It is an important craft along with weaving, macramé, knitting, and other needlework techniques. Dona Z. Meilach

Crockett, Davy (1786-1836), was one of the most famous frontiersmen in United States history. He became known as a hunter and Indian fighter and used his reputation to build a political career. Crockett succeeded Daniel Boone as the nation's best-known symbol of the American frontier. Many people felt the national spirit of the United States was reflected in Crockett's motto: "Be always sure you're right—then go ahead!" Crockett died fighting in the war for Texas independence. His life and death became a part of both history and legend.

Early life. David Crockett was born in Greene County, Tennessee, on Aug. 17, 1786. The Crockett family moved to Jefferson County, where Davy's father opened a tavern in 1796. Davy started school at about the age of 13. He often played hooky, and he ran away from home for about $2\frac{1}{2}$ years to avoid being punished for missing class. In 1806, Crockett married Mary (Polly) Finley, the daughter of a farmer. They had three children.

In 1813, Crockett became a U.S. Army scout. He fought in the Creek Indian War in what is now part of Alabama and Florida until 1815. His wife died that year. In 1816, Crockett married Elizabeth Patton, a widow with two children. They moved to western Tennessee.

Political career. In Tennessee, Crockett developed a successful political career. He held several local positions, including justice of the peace, town commissioner, and colonel of the county militia. Crockett served in the Tennessee legislature from 1821 to 1824. He won a seat in the United States House of Representatives from Tennessee in 1827 and was reelected in 1829 and 1833.

In Congress, Crockett opposed President Andrew Jackson and other Tennessee members of Congress on several issues, including land reform and a bill to relocate Indian tribes. Whig Party leaders promoted Crockett as a presidential candidate for the election of 1836. But Crockett lost his reelection bid for Congress in 1835, and his presidential ambitions ended.

The Alamo. In November 1835, Crockett set out for Texas. He felt he could renew his political career there and become wealthy as a land agent. At the time, Texas was fighting to gain its independence from Mexico. In early February 1836, Crockett joined 188 men who had established a fort at the Alamo, an old Roman Catholic mission in San Antonio. When Mexican troops attacked the fort, the men held them off for nearly two weeks. But on March 6, the Mexican forces overran the Alamo. Some historians believe that a few men, perhaps including Crockett, survived the battle but were then executed by the Mexicans. Other scholars believe that all the defenders died in the battle.

The legends. Crockett excelled at *backwoods brag,* a type of country exaggeration, and he told many tall tales about himself. In one tale, a raccoon gives up when Crockett spots him while hunting. Crockett also may have been exaggerating when he claimed to have killed 105 bears in seven months.

Detail of *Fall of the Alamo* (1903), oil painting on canvas by Robert Onderdonk; Governor's Mansion of Texas (Friends of the Governor's Mansion)



Davy Crockett fought at the Alamo to help Texas win its independence from Mexico. In 1836, a Mexican army attacked the Alamo, an old Roman Catholic mission used by Texans as a fort. Although greatly outnumbered and low on ammunition, Crockett, *standing center left,* and 188 other defenders held off the Mexicans for nearly two weeks before losing the fort.

Crockett became known for political antics as well. For example, he once memorized an opponent's standard speech and spoke it word for word as his own at a debate. Not being able to repeat the same speech, his confused rival was forced to make an unprepared reply.

Stories written after his death helped create the fictional legends of Davy Crockett. One description claimed that he could "run faster, jump higher, squat lower, dive deeper, stay under longer, and come out drier than any man in the whole country." Through the years, Crockett has been the subject of songs, books, TV programs, and movies. Michael A. Lofaro

See also **Alamo**; **Pioneer life in America** (Places to visit).

Additional resources

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Crocodile is one of the largest living reptiles. Crocodiles, alligators, gavials, and caimans look much alike, and are all called *crocodilians.* Both crocodiles and alligators have a long, low, cigar-shaped body, short legs, and long powerful tails with which they swim. They both have tough hides, long snouts, and sharp teeth to grasp their prey. In most crocodiles, however, the snout comes to a point in front, where an alligator's snout is rounded. The American crocodile is only about two-thirds as heavy as an old American alligator of the same length and can move much more quickly. The lower fourth tooth is extra long in both animals. It fits into a pit in the alligator's upper jaw. But the crocodile's fourth tooth fits into a groove in the side of the upper jaw, and it is visible when the animal's jaws are closed.

Crocodiles live in tropical countries throughout the world. They prefer large bodies of shallow water, sluggish rivers, open swamps, and marshes. Their webbed feet allow them to walk on the soft ground. Their eyes and nostrils are higher than the rest of the head. This arrangement fits in with the crocodile's life in the water, for it likes to float with only its eyes and nostrils above the surface. Its throat has a slitlike valve in front of the tube leading to its nostrils. This valve shuts tight when the animal is underwater. It keeps the water from entering through the mouth when the reptile seizes its prey.

Crocodiles eat many small animals, such as fishes, birds, and turtles, which they swallow whole. Occasionally they attack large animals and people. A crocodile can twist a large animal into pieces by seizing it and then rapidly spinning lengthwise in the water. Crocodiles are more aggressive than American or Chinese alligators. Large wild crocodiles should be left alone.

Like most reptiles, crocodiles lay eggs. These look like hens' eggs, but are longer and have a less brittle shell. Crocodiles conceal their eggs in nests of rubbish and vegetation, or they bury them in sand beaches. The female of some types guards the nest until the young are hatched. When she can hear the young reptiles grunting, she digs them out of the nest. Some crocodiles help their young hatch and then carry them in their mouth to the water. Not much is known about the breeding habits and general behavior of crocodiles.

Most of the true crocodiles inhabit the Eastern Hemisphere, but four species live in North and South America. The *American crocodile* lives in the extreme south of Florida, on the larger West Indian islands, and in Central America and areas near it. The usual length of adult

Marc & Evelyne Bernheim, Woodfin Camp, Inc.



A crocodile's body is long, low, and cigar-shaped. It has a tough hide. The animal uses its short legs mainly for walking on land. It uses its long, powerful tail to swim.



Caulion Singletary

A baby American crocodile hatches after about 105 days. At birth, it measures about 9 inches (23 centimeters) long.



E. R. Degginger

A crocodile's long snout has sharp teeth. Its teeth are set in strong jaws that can snap a heavy board in two.

American crocodiles is about 12 feet (3.7 meters).

The *Nile crocodile* is found widely in Africa. It lives almost everywhere on the continent except in the Sahara and on the northern coast. This reptile was known by ancient peoples and described by the Greek historian, Herodotus. The small, long-snouted crocodile of the Congo Basin grows no longer than 8 feet (2.4 meters). The two kinds of dwarf crocodilians of Africa, one of which is very rare, are closely related to true crocodiles.

The giant *saltwater crocodile* lives in many places from India to northern Australia, and even in the Solomon Islands. The *mugger* lives in India and Pakistan, and the *Siamese crocodile* inhabits Java, Thailand, and nearby parts of Asia. There is also an *Australian crocodile.* Sumatra and the Malay Peninsula have the *false gavial.* The false gavial has a narrower snout than most other crocodilians. It uses its long snout to catch fish.

The crocodilians are remnants of a large and ancient group of reptiles. Fossils show that these reptiles once reached a length of 50 feet (15 meters). This is more than twice as long as any crocodiles living today. There are now 14 species of crocodiles.

Crocodiles have been widely hunted for their hides, which manufacturers make into leather for shoes and handbags. Such hunting has caused three species—the American crocodile, Cuban crocodile, and Nile crocodile—to become endangered species. Laws now forbid crocodile hunting in many parts of the world, but these restrictions are difficult to enforce. Biologists in some areas have begun programs to collect crocodile eggs and hatch them in incubators. The baby crocodiles are then released into the wild. D. Bruce Means

Scientific classification. Crocodiles belong to the family Crocodylidae. The Nile crocodile is *Crocodylus niloticus.* The American crocodile is *C. acutus.*

See also **Alligator; Gavial; Reptile.**

Crocodile bird. See Courser.

Crocus, *KROH kuhs,* is the name of a group of small flowering plants native to southern Europe and Asia and cultivated in many regions of the world. A crocus grows from a thick, bulblike stem called a *corm.* The leaves look like large blades of grass. The flower consists of six nearly equal segments and may be white, yellow, or purplish. Some crocuses bloom early in spring, and others in the autumn. A popular spring-blooming species, the *cloth-of-gold crocus,* has a bright orange-yellow flower. Most crocuses grow only about 3 or 4 inches (8 to 10 centimeters) high.



George Nelson, Artstreet

Crocuses

Gardeners plant crocuses about 3 inches (8 centimeters) deep in rich soil. After the plants bloom, the corms die and new ones grow in their place.

Crocus is the Latin word for *saffron.* Saffron was once used extensively to make a yellow dye and as a spice for food. Commercial saffron is obtained from the *saffron crocus,* which is grown mainly in France, Italy, and Spain. See **Saffron.**

The colchicum is a flowering plant that closely resembles crocuses. It is often called autumn crocus or meadow saffron (see **Colchicum**). The wild crocus, or pasqueflower, is an anemone (see **Pasqueflower**).

Kenneth A. Nicely

Scientific Classification. Crocuses make up the genus Crocus in the iris family, Iridaceae. The scientific name for the cloth-of-gold crocus is Crocus angustifolius. The saffron crocus is C. sativus.

See also **Flower** (picture: Garden perennials [Bulbs]).

Croesus, *KREE suhs* (reigned 560-546 B.C.), was the last king of Lydia, a country in what is now western Turkey. Croesus raised Lydia to the peak of its power, conquering Greek coastal cities and extending his empire to the Halys River (now called the Kizil River) in central Asia Minor. During Croesus's reign, Lydia achieved vast wealth through gold mining and extensive trade.

Croesus succeeded his father, Alyattes, as king. In 549 B.C., he formed an alliance with Babylonia, Egypt, and Sparta against Persia. He attacked the Persians about 545 B.C., expecting help from his allies. But help could not reach him, and he withdrew to Sardis, his capital. Cyrus, the Persian leader, followed him there, defeated him, and made Lydia part of the Persian Empire. Clive Foss

Crohn's disease, *krohnz,* is an illness characterized by inflammation of the *gastrointestinal tract* (the stomach and intestines). The disease usually affects the lower part of the small intestine, called the *ileum,* and parts of the large intestine. The disease is also called *ileitis, regional enteritis,* or *granulomatous colitis,* depending upon the location of the inflammation. Crohn's disease is similar to *ulcerative colitis,* and together they are referred to as *inflammatory bowel disease.* See **Inflammatory bowel disease.**

Symptoms of Crohn's disease vary. They include periodic episodes of abdominal cramps, fever, diarrhea, poor appetite, and weight loss. These symptoms can range from mild to severe. Other symptoms can include joint pain, mouth sores, skin lesions, and inflammation of the eyes and liver. Severe cases of the disease can cause intestinal blockage, scarring, and accumulations of pus within the abdomen. In most cases, symptoms first appear in people between the ages of 15 and 30. When Crohn's disease occurs in children, it can delay normal growth and development.

Medical scientists do not know what causes Crohn's disease. There is evidence that some people may have an inherited tendency for developing the disease. Some researchers believe that the inflammation is a response to an infectious organism, such as a bacterium or virus. Others think the disease is caused by an abnormal reaction of the immune system. During this reaction, the body attacks its own healthy tissue in the gastrointestinal tract.

There is no cure for Crohn's disease. Physicians treat the disease with steroid hormones and other anti-inflammatory drugs. Antibiotics may also be used. In severe cases, surgery to remove portions of the intestine may be necessary. Keith J. Benkov

Crompton, Samuel (1753-1827), was an English weaver and inventor. In 1779, he developed an improved spinning machine that led to major growth in the cotton industry. His new machine was called *the mule* because it was a cross between two machines, the spinning jenny and the water frame, just as a mule is a cross between two animals. The mule made the strong, uniform cotton yarn that was required for fine muslin and calico.

Crompton did not get a patent on his machine, and he received little of the money that cloth manufacturers promised him. But Parliament gave him a national gift of £5,000 in 1812 when he was able to show that the many mules in use had revolutionized the cotton industry. Crompton was born on Dec. 3, 1753, in Firwood, Lancashire. Richard F. Hirsh

Cromwell, Oliver (1599-1658), led the armed forces of Parliament to victory in the English Civil War in the 1640's and ruled England from 1653 to 1658. He had an iron will and was a military genius. Few leaders have inspired more love and respect or more fear and hatred.

Cromwell was born on April 25, 1599, in Huntingdon, England, near Peterborough. He came from a wealthy and influential family. Cromwell studied at Sidney Sussex College in Cambridge, but his father's death forced him to leave before getting a degree.

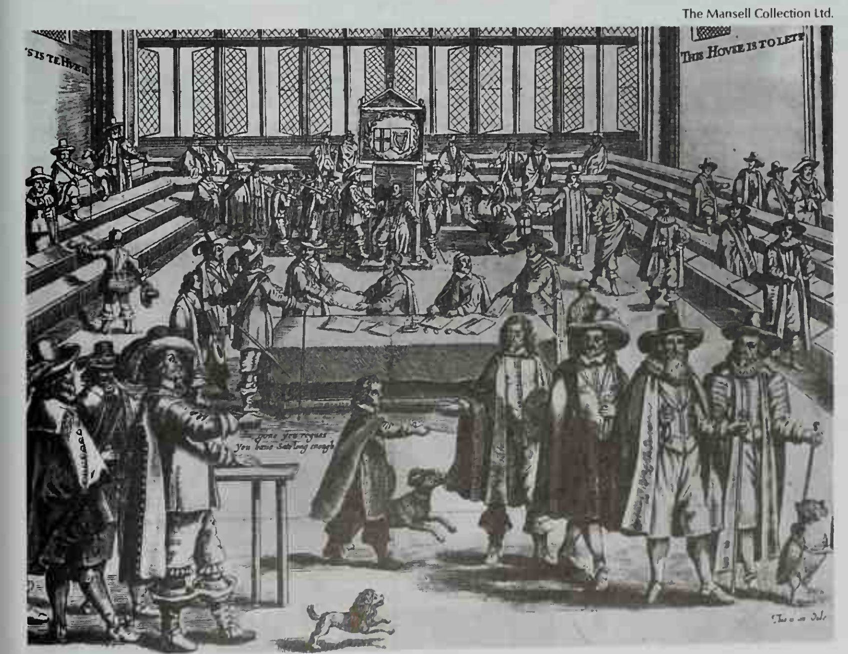
In 1628, Cromwell was elected to Parliament. During the 1630's, he became a dedicated Puritan. Puritans were Protestants who strongly believed in the right of people to follow more simple forms of worship and church organization than those of the Church of England (see **Puritans**).

Rise to power. In 1629, King Charles I dismissed Parliament. He believed that kings got their right to rule from God, not from the people. Charles showed little respect for Parliament and did not call it to meet until 1640, when he needed it to provide money.

The struggle for power between the king and Parliament resumed, and civil war broke out in 1642. Cromwell had won election to Parliament in 1640, and he became its leading general. He had no military experience, but he turned out to be a brilliant cavalry leader. His forces, called the "Ironsides," never lost a major battle. In 1645, Cromwell won the decisive Battle of Naseby. The king surrendered in 1646.

Parliament's supporters split into two rival groups. These two groups were the Presbyterians and the Independents. The Presbyterians, who had the majority of the seats in Parliament, wanted Parliament and the king to share political power. Some of the independents,

The Mansell Collection Ltd.





Crayon drawing by Samuel Cooper; Sidney Sussex College, Cambridge, England (Stearn's and Sons, Ltd.)

Oliver Cromwell, *above*, ruled England from 1653 to 1658. He dismissed Parliament in 1653, *left*, because it failed to adopt major reforms. Cromwell is shown at the bottom of the left side of the drawing wearing a plumed hat and pointing a staff.

whose supporters included the chief officers of the army of Parliament, favored formation of a republic governed entirely by Parliament.

Fighting between the king's sympathizers and the Independents broke out in 1648. Cromwell supported the Independents and put down the revolt. Soon afterward, Parliament's army seized Charles and removed the Presbyterian members of Parliament. Cromwell was a leader in the king's trial and execution in 1649. England then became a republic called the Commonwealth of England. In the next two years, Cromwell crushed uprisings by Scottish and Irish forces and defeated an army loyal to Charles Stuart, son of the executed king.

The Protectorate. Parliament's failure to adopt major reforms upset Cromwell. In 1653, he dismissed Parliament and ended the Commonwealth. Cromwell's military officers then prepared a document that made England a Protectorate. Cromwell became its chief executive with the title of *lord protector.*

Cromwell limited freedom of the press, demanded rigid moral standards, and adopted other strict measures. He also strengthened England's navy and brought Scotland and Ireland under English control. In addition, Cromwell aided the development of English colonies in Asia and North America. In 1657, Parliament offered Cromwell the title of king, but he refused it.

After Cromwell died in 1658, his son, Richard, became lord protector. But Richard was an ineffective ruler and resigned in 1659. In 1660, Parliament invited Charles Stuart to rule as King Charles II. Roger Howell, Jr.

Related articles in ***World Book*** include:

Charles I
Charles II (of England)
England (The Civil War)
Long Parliament
Restoration
Rump Parliament

Cromwell, Richard (1626-1712), ruled England as lord protector from September 1658 to May 1659. He succeeded his father, Oliver Cromwell, as lord protector. But he could not govern effectively, and a group of political and army leaders forced him to resign. In 1660, Parliament invited Charles Stuart to return from the Continent and rule as Charles II. Cromwell fled to France. He returned to England about 1680 and lived under another name in Cheshunt until his death.

Cromwell was born in Huntingdon. He fought with Parliament's forces against King Charles I during the English Civil War in the 1640's. Cromwell was admitted to the Council of State and was named chancellor of Oxford University in 1657. Vernon F. Snow

Cromwell, Thomas (1485?-1540), was a trusted adviser to King Henry VIII of England. A talented and ruthless administrator, Cromwell directed England's civil and religious affairs in the 1530's.

Cromwell is often called the architect of the English Reformation for his part in establishing Protestantism in England. Pope Clement VII had resisted granting Henry's request to *annul* (cancel) his marriage to Catherine of Aragon. Cromwell showed Henry he could get the marriage annulled by breaking with the Roman Catholic Church and by becoming head of an independent Church of England. Cromwell seized property of monasteries and demanded total obedience to the new religion. But later he fell from favor and was beheaded.

Historians believe Cromwell was born in Putney, England. He became an assistant to Thomas Cardinal Wolsey in 1524. Wolsey fell from power in 1529. Within a few years, Cromwell became principal secretary, vicar general, and lord privy seal. He was made Earl of Essex in 1539. Lacey Baldwin Smith

Cronin, A. J. (1896-1981), was a popular British novelist. He gained literary fame with his first novel, *Hatter's Castle* (1931), a story of country life in Scotland. Cronin developed a pattern of centering his novels on a single problem or profession, treating it with an engaging combination of realistic detail and romantic plotting. *The Stars Look Down* (1935) describes poor working conditions in an English mining community. *The Citadel* (1937) is the story of a young Scottish doctor and also a critical study of the medical profession. *The Keys of the Kingdom* (1941) is a moving story about a Roman Catholic missionary priest in China. Cronin's later novels include *A Thing of Beauty* (1956), *A Pocketful of Rye* (1969), and *The Lady with Carnations* (1976).

Archibald Joseph Cronin was born in Cardross, Scotland. He practiced medicine from 1919 to 1930. Cronin moved to the United States in the mid-1940's. His autobiography, *Adventures in Two Worlds* (1951), deals with his early years as a doctor. Garrett Stewart

Cronkite, Walter (1916-), an American journalist, became famous as a television newscaster. He was anchorman of "The CBS Evening News" from 1962 to 1981. He won praise for his reporting of America's adventures into space and for organizing CBS's coverage of elections and the Vietnam War.



CBS News

Walter Cronkite

Walter Leland Cronkite was born in St. Joseph, Mo. He reported for Scripps-Howard Newspapers while attending the University of Texas at Austin from 1933 to 1935. After leaving school, he worked at *The Houston Post* and took jobs as a radio announcer.

From 1937 to 1948, Cronkite worked for United Press (now United Press International). He was a European correspondent during World War II and later managed the Moscow bureau. In 1948, he returned to radio as a reporter. Cronkite joined CBS in 1950. He was a correspondent in Washington and in New York City before becoming anchorman. He retired from CBS in 1981. Since then, he has worked on documentaries and special assignments for CBS. Keith P. Sanders

Cronus was the youngest child of Gaea, the earth; and Uranus, the sky, in Greek mythology. Unlike most gods, he did not represent a place, event, function, or quality. Cronus belonged to the race of gods known as Titans. The Roman god Saturn became identified with him.

Uranus feared his children and confined them within Gaea's huge body. With Gaea's help, Cronus castrated and deposed Uranus and became king of the Titans. Cronus married his sister Rhea, and they had six children. Cronus feared that his children would depose him, and so he swallowed the first five of them at birth. Rhea hid the last child, Zeus, on the island of Crete. Then she tricked Cronus by giving him a large stone

wrapped in baby clothes. After Zeus grew to manhood, he tricked Cronus into vomiting up his brothers and sisters. Together, they deposed their father, and Zeus then became the king of the gods. C. Scott Littleton

See also Mythology (Greek mythology); Titans.

Crookes, Sir William (1832-1919), was a British chemist and physicist. Crookes discovered the chemical element thallium and determined its atomic weight. He also developed several devices that were widely used in scientific research for many years.

During the 1870's, Crookes constructed a vacuum tube for studying a form of radiation that came to be called *cathode rays.* This device, which became known as the *Crookes tube,* contributed to the development of the modern *cathode-ray tube* that is used in electronic equipment. A television picture tube is a type of cathode-ray tube. Crookes was also the inventor of the *radiometer,* a device that measures the intensity of radiant energy.

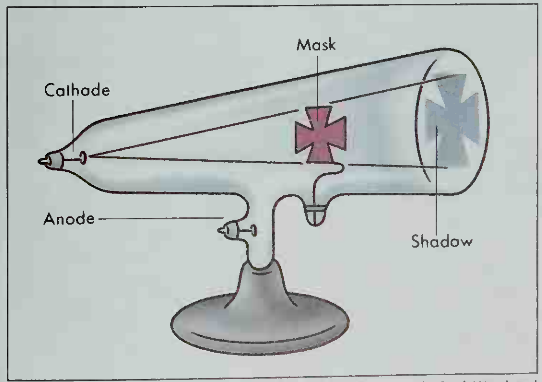
Crookes was born on June 17, 1832, in London and graduated from the Royal College of Chemistry in 1851. In 1859, he founded the journal *Chemical News.* He was knighted in 1897. Romualdas Sviedrys

See also Crookes tube; Vacuum tube.

Crookes tube is a type of vacuum tube. William Crookes, an English physicist and chemist, developed the tube in the 1870's as part of his study of what came to be called *cathode rays.* His work led to the discovery that these rays consist of streams of electrons.

A Crookes tube has electrodes at or near each end, and low air pressure inside. When a strong electric current flows from the *cathode* (negative electrode) to the *anode* (positive electrode), a glow appears in the end of the tube opposite the cathode. Crookes concluded that invisible rays from the cathode caused the glow. To study the rays, Crookes placed small objects in the rays' path within the tube.

In 1879, Crookes suggested that the rays consisted of streams of negatively charged molecules. The English physicist Joseph John Thomson confirmed that the rays were charged particles of matter in 1897. Crookes tubes were forerunners of television picture tubes. Today, the Crookes tube is used only for classroom demonstrations. Bernard S. Finn



WORLD BOOK illustration by Sarah Woodward

A Crookes tube produces cathode rays. These rays cause glass at the opposite end of the tube to *fluoresce* (give off light). A metal mask blocks some of the rays and casts a shadow.

Crop is a large number of plants of any given kind that are grown for human use. Crops grown to feed people are called *food crops.* Crops eaten by animals are *feed crops.* Other crops, called *fiber crops,* produce fiber for use in clothing and other products. Some crops are grown to *ornament* (decorate) people's surroundings.

Food crops include fruits, vegetables, and grains. Animal feed crops include *forage,* such as grasses and certain herbs. Cotton, flax, and hemp provide fiber. Ornamental crops include flowers, lawn grasses, shrubs, and decorative trees. James D. Arnold

See also Agriculture (Chief agricultural products).

Crop insurance provides protection for a farmer's income in case bad weather or other unavoidable hazards cause crop losses. There are two main types of crop insurance sold in the United States—*multiperil insurance* and *hail insurance.* Both types are designed to provide coverage for only a fraction of a farmer's crop.

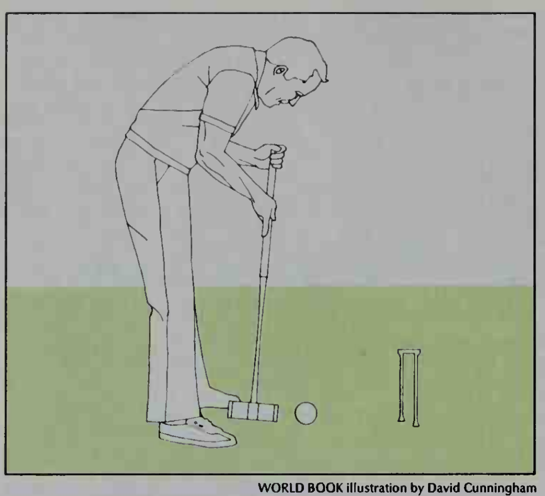
Multiperil insurance is sold by private agents. However, the Farm Service Agency of the United States Department of Agriculture guarantees the availability of money for the payment of claims. Multiperil insurance covers losses due to almost all natural causes, including disease, drought, flood, and insects. The insurance is available for corn, cotton, tobacco, wheat, and about 50 other crops. In some areas, multiperil insurance also protects farmers against large drops in the market price of a crop.

Hail insurance is sold by private agents, whose companies also pay the claims on crop losses. Its coverage is limited to losses caused by hail, wind, or fire. This insurance is restricted to only a few causes in order to offer some protection for the insurer. A private insurer, unlike a government agency, could be ruined if crop losses occurred over a wide area. Warren F. Lee

Crop rotation. See Cropping system.

Cropping system is a method of growing crops and producing high yields without weakening the soil. It involves the combination of different production techniques to provide for the best possible use of the land. In determining the crops and production methods best suited for their land, farmers must consider the composition of their soil; the slope, drainage, and *erosion* (wearing away) problems of their land; and the land's past cropping history. Such production techniques as different cultivation methods, rotation of crops, and the proper use of fertilizers and pesticides are used in different combinations to aid the farmer.

One of the oldest and most widely used ways of preserving the soil is through the *rotation of crops* (alternating the crops grown in a field from one year to the next). A single crop will use up vital minerals and organic matter in the soil if it is grown in the same field year after year. But different kinds of crops planted in the field on a regular schedule will replace lost minerals and organic matter and help break up plant disease and insect cycles. For example, corn takes nitrogen out of the soil, but such crops as alfalfa and clover put nitrogen into the soil. If corn is planted in a field one year, alfalfa or clover may be planted the next year to replace the nitrogen used by the corn crop. The nitrogen-producing crop can also be plowed into the soil. When it rots, it replaces lost organic matter and enriches the soil. On sloping land, grasses and deep-rooted crops are frequently



WORLD BOOK illustration by David Cunningham

WORLD BOOK diagram

A croquet player scores a point by hitting the ball through a wicket with a mallet. The diagram shows the required course of the balls through the six wickets.

alternated with other crops to hold the soil in place and prevent erosion.

The use of fertilizers is gradually replacing the crop rotation system as a means of producing the most profitable crops year after year while still keeping soil fertile. Nitrogen fertilizers and other fertilizers have been developed that can restore lost minerals to soil. When these fertilizers are added, and the proper cultivation and pest control methods are used, the same crop can be planted year after year without harming the soil.

Other developments that aid the farmer include chemical pesticides that kill harmful insects, weeds, and microorganisms. James D. Arnold

Croquet, *kroh KAY,* is a popular outdoor lawn game in which the players use mallets to hit balls through narrow arches called *wickets.* Croquet originated in France during the late 1400's and was first played in the United States in the 1860's. Today, top players of several nations compete in the sport of croquet, but it is largely a backyard game in the United States. There are many versions of croquet. This article discusses the tournament version used by the U.S. Croquet Association.

The court and equipment. A standard croquet court measures 105 feet (32 meters) long and 84 feet (26 meters) wide. In a game, each side uses wooden mallets and two wooden balls. A croquet mallet weighs from 2 to 4 pounds (0.9 to 1.8 kilograms). It has a handle 2 to $3\frac{1}{2}$ feet (61 to 107 centimeters) long and a head 10 inches (25 centimeters) long. Each ball is blue, red, black, or yellow. The balls are played in this order throughout a game. A croquet ball has a diameter of $3\frac{5}{8}$ inches (9.2 centimeters) and weighs about 1 pound (0.5 kilogram).

A wooden stake stands in the center of the court. It has a diameter of $1\frac{1}{2}$ inches (3.8 centimeters). Six iron or aluminum wickets are at designated places on the court. They are 12 inches (30 centimeters) high and must be no more than 4 inches (10 centimeters) wide.

The game. Each of the two competing sides in a game of croquet has either one or two players. Each player scores points by hitting his or her ball along a required course through the wickets and back again. A player uses two balls in a singles game. A point is scored each time a ball passes through a wicket or hits the stake at the end of the course. The first side to score 26 points wins the game.

Each ball must be played in turn. A player may hit his or her ball only once at the start of each turn. But if the ball goes through its wicket in its proper order, the player gets one additional stroke.

A player whose ball hits another ball earns two more strokes. For the first of these, he or she may take one of three shots. (1) The player may place his or her ball against the other ball, striking it so that both balls are driven away. (2) The player may hit his or her ball while holding it next to the other ball with one foot, thus driving the other ball away. (3) The player may hit his or her ball away after moving the ball the length of a mallet head from the other ball. A player takes one of these strokes before taking the second, or *continuation,* stroke. A player whose ball has hit another ball is considered *dead* on that ball. That is, the striker's ball cannot hit that same ball again until it has scored the next wicket point. Jack R. Osborn

Crosby, Bing (1903-1977), was a popular American singer and motion-picture star. He became especially well known for his relaxed "crooning" style of singing. Crosby made about 60 movies, most of which were musicals and romantic comedies. He introduced his most famous song, "White Christmas," in the movie *Holiday Inn* (1942). Crosby won an Academy Award in 1944 for his performance as a singing priest in *Going My Way.* He also co-starred with Bob Hope and Dorothy Lamour in *Road to Singapore* (1940) and six later "Road" comedies.



Wide World

Bing Crosby

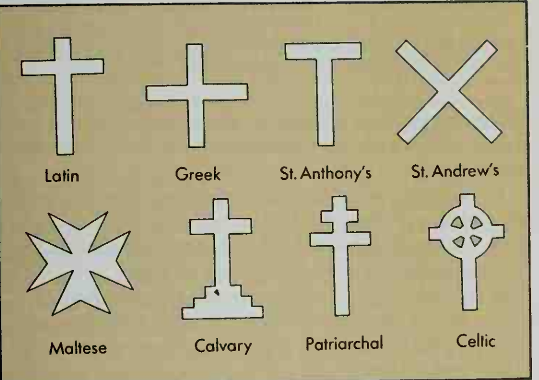
Crosby was born in Tacoma, Wash. His real name was Harry Lillis Crosby. He started his career in 1924 singing

with a Los Angeles band. From about 1927 to 1930, he sang with a trio called the Rhythm Boys. Film and radio appearances and phonograph records made Crosby nationally famous in the 1930's. Crosby was married to actress Dixie Lee from 1930 until her death in 1952. They had four sons. In 1957, Crosby married actress Kathryn Grant. They had two sons and a daughter. Roger Ebert

Cross is the most common symbol of Christianity. It represents the cross on which Jesus Christ was crucified. Christians believe that Jesus' Crucifixion played a central role in redeeming humanity from its sins, and they regard the cross as a sign of redemption. Various groups of Christians have adopted different styles of crosses. Roman Catholics and Protestants chiefly use the Latin cross. This cross is a vertical post with a shorter horizontal crosspiece above the center. Many Eastern Orthodox Churches use the Greek cross, which has four arms of equal length.

During the first 300 years after Christ's death, Christians feared persecution by the hostile Roman government and rarely displayed the cross in public. In the 300's, the Romans began to tolerate Christianity, and crosses were widely displayed. During the early Middle Ages, Christian artists made crosses as symbols of the Christian belief in the Resurrection of Christ. Many of these crosses portrayed the risen Christ wearing priestly clothes and a royal crown. Later, Christians began to emphasize the sufferings of Jesus in *crucifixes.* A crucifix is a cross with an image of the dying Jesus.

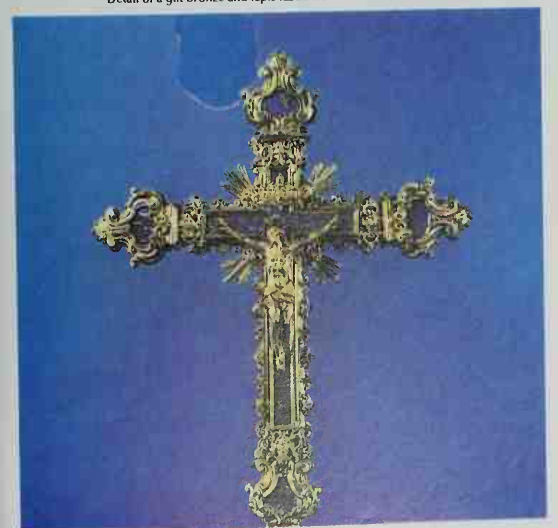
Crosses have a number of uses in Christian worship. A cross on a staff is carried in many processions. During some ceremonies, members of the clergy or worshipers trace the shape of a cross with a hand or certain fingers. Cathedrals and many churches have floor plans based on the shape of the Latin cross. Jill Raitt



WORLD BOOK illustration by Arthur Grebetz

The cross is the most familiar symbol of Christianity. The illustration above shows eight styles of crosses that became famous in the history of the religion. The picture below shows a *crucifix,* which is a cross with an image of the crucified Jesus Christ.

Detail of a gilt bronze and lapis lazuli crucifix (1700's); The Art Institute of Chicago



Cross-country is a type of long-distance racing. Unlike track and field races, cross-country competition is not held on a track. Runners usually race across fields or golf courses and often through woods and over hills. Because distances and terrains differ for each race, no national or world records exist for this event. In the United States, the National Federation of High School Associations has set a minimum distance of $1\frac{1}{2}$ miles (2.4 kilometers) and a maximum distance of 3 miles (4.8 kilometers) for races. The National Collegiate Athletic Association has set a distance of 5 kilometers ($3\frac{1}{10}$ miles) for women and between 8 and 10 kilometers (5 and $6\frac{1}{5}$ miles) for men. The Athletics Congress conducts championships at distances of 10 kilometers for men and 6 kilometers ($3\frac{3}{4}$ miles) for women. Michael Takaha

Cross-examination. See **Debate; Trial.**

Cross-eye. See **Strabismus.**

Cross-reference is a method used in books, indexes, library catalogs, and filing systems to direct attention to additional information about a subject in another part of the book or index. Cross-references are widely used in encyclopedias, dictionaries, and textbooks. For instance, this article on **Cross-reference** mentions indexes. At the end of the article there is a cross-reference reading "See also **Index.**" The reader can find more information about indexes in that article. This type of cross-reference is sometimes called a *related subject* or a *related article.*

Cross-references may also appear within the text of an article or chapter. *The World Book Encyclopedia* article on the famous American author whose pen name was Mark Twain illustrates another kind of cross-reference. Because the author is best known as Mark Twain, his biography is given under Twain, Mark. But because his real name was Samuel Langhorne Clemens, there is an entry **Clemens, Samuel Langhorne,** which refers the reader to the article on Mark Twain in inverted form: Twain, Mark. This is a direct reference, and will be "See **Twain, Mark.**" Some publications use the symbols *cf.* (from the Latin *confer,* meaning *compare*), or *q.v.* (from the Latin *quod vide,* meaning *which see*).

Charles F. Sieger

See also **Index.**

Crossbill is the name of several species of small birds. The upper and lower parts of the bill of these birds cross each other at the ends.

The male *red,* or *American, crossbill* is colored brick red, with wings and tail of brown. It is about the size of a house sparrow. The plumage of the female is a slightly mottled, greenish yellow. This bird breeds from the



WORLD BOOK illustration by John Rignall, Linden Artists Ltd.

The crossbill uses the crossed ends of its bill to get seeds from fir cones. The male red crossbill, *above,* is brick red.

northern states northward. In the region of the Allegheny Mountains, it breeds as far south as the Carolinas. In winter, red crossbills migrate in small flocks to the Gulf of Mexico, and west as far as Idaho and Arizona. They build their nests in evergreens. The female lays three or four pale-greenish eggs with purple or lilac spots. Red crossbills feed chiefly on seeds of cone-bearing trees. They also eat small quantities of buds and a few insects. The bird uses its crossed bill to lift the scales from the cones to get the seeds.

The *white-winged crossbill* is similar in habits to the red crossbill. It breeds from the northern states northward. In winter, it migrates as far south as Virginia.

Scientific classification. The crossbills belong to the finch family, Fringillidae. The red crossbill is *Loxia curvirostra.* The white-winged crossbill is *L. leucoptera.* Sandra L. Vehrencamp

Crossbow was a weapon used for shooting arrows, especially during the Middle Ages. It had a stout bow mounted horizontally across the end of a handle called a *stock* or *tiller.* To load the crossbow, the archer drew the bowstring back to a catch called a *nut.* To shoot, the archer pulled a trigger that released the string from the hook.



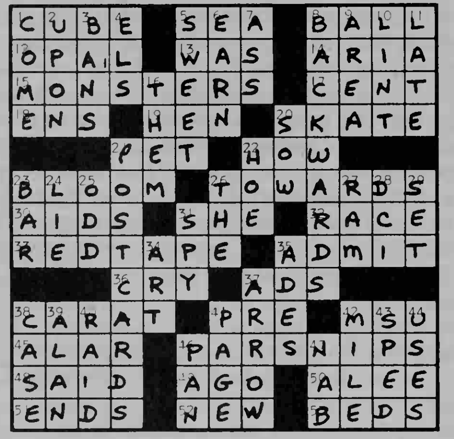
Detail of an illuminated manuscript by an unknown artist; Bibliothèque Nationale, Paris

Turkish forces fought with crossbows in 1480. Some archers used cranks to prepare their crossbows for shooting.

The most powerful crossbows needed a special cocking machine to draw the bowstring back. Archers could cock smaller crossbows by placing the bow against the feet and pulling the bowstring back by hand.

In ancient times, the Chinese used a simple kind of crossbow. During the Middle Ages in Europe, special infantry units consisted entirely of soldiers armed with crossbows. By the 1500's, the longbow had gained popularity because it was faster to operate. The development of weapons that used gunpowder also reduced the crossbow's value in war. Richard A. Sauers

Crossword puzzle is a popular word game. It is commonly played on a diagram of black and white



Harle Publications, Inc., 1973

Crossword puzzle clues have numbers corresponding to numbered squares in a diagram. When the puzzle is completed, each square will have a letter that helps to spell a word.

ACROSS

1. Lump of sugar
5. Galilee, for example
8. Batter's target
12. October birthstone
13. Used to be
14. Diva's specialty
15. Bogeymen
17. Penny
18. Printer's measures
19. Barnyard clucker
20. Play ice hockey
21. Cat, dog, or canary
22. Indian's greeting
23. Blossom
26. In the direction of
30. Lends a hand
31. That girl
32. Indianapolis 500, for example
33. Troublesome bureaucratic complexity: 2 words
35. Confess
36. Shed tears
37. Sale announcements
38. Diamond size
41. Before: prefix.
42. Spartan campus at East Lansing: abbr.
45. Winglike
46. Vegetables
48. Declared
49. Long past
50. Away from the wind
51. Book holders
52. Original
53. Four-posters

DOWN

1. Arrive
2. Atop
3. Prohibits
4. Kays, ____, ems
5. ____ sixteen
6. Deserve
7. Donkey
8. In a reverse direction
9. Neighborhood
10. Bit of fluff
11. Behind time
16. Those people
20. Scatter seeds
21. Greetings from vacationers
22. Till the soil
23. Snack counter
24. Fib
25. Peculiar
26. Nothing but ____ best
27. Ewe's mate
28. 601: Roman numerals
29. Solidify
31. Foreign agent
34. Museum treasure
35. Summer beverages
37. Direction indicator
38. Attorney's concern
39. Chester ____ Arthur
40. Surprise attack
41. Book segment
42. Distance measure
43. Scurried
44. Puts into operation
46. Pot's relative
47. Arrest

squares. A set of numbered definitions or clues is usually printed near the diagram. The object is to answer the clues with words interlocking across and down the diagram. The player writes in each answer word in the row of empty squares starting at the number corresponding to the number of the clue.

Arthur Wynne created the first modern crossword puzzle, which appeared in the Sunday *New York World* newspaper on Dec. 21, 1913. The puzzle became a fad in the United States and spread to other countries. Today, crosswords appear in many languages throughout the world. Puzzle championships are often held in the United States and other countries. Will Shortz

Croton, *KROH tuhn,* is the name of a group of tropical shrubs or small trees. The best-known type is the *garden croton,* which grows about 3 to 8 feet (0.9 to 2.4 meters) high. Its smooth-edged leaves may be spotted, streaked, or banded with yellow, white, green, and red. Because of these colors, the leaves are often used in wreaths. On some garden crotons no two leaves have the same pattern. The white flowers are small and hardly noticeable. The fruits are round and split into three segments. Garden crotons grow best in good, moist soil. They can be kept indoors in pots. In tropical climates, they are often grown outdoors in lawns and parks.

Scientific classification. The garden croton belongs to the spurge family, Euphorbiaceae. Its scientific name is *Codiaeum variegatum pictum.* Walter S. Judd

Croup, *kroop,* is an inflammation of the air passages of the throat and *trachea* (windpipe). During an attack of croup, the mucous membranes in these areas become inflamed and swollen, restricting the flow of air. A victim of croup feels hoarse, breathes with great difficulty, and wheezes when inhaling. The patient also develops a hollow, barking cough. Croup occurs most often among children who are 6 months to 3 years old. Their air passages are smaller and more easily blocked.

Most croup results from influenza, a cold, or some other respiratory infection caused by a virus. Attacks of viral croup last three or four days. In mild cases, physicians prescribe bed rest and breathing moist air from a vaporizer. In severe cases, the patient may receive oxygen and a mist of a drug that widens the breathing passages. If the air passages become completely blocked, the physician performs an *intubation* or a *tracheotomy.* An intubation involves inserting a tube into the nose or mouth and through the swollen throat to the lungs. In a tracheotomy, the doctor cuts an opening through the neck into the trachea below the blockage.

Croup may also be caused by allergic reactions or bacterial infections. Drugs used to treat asthma help relieve croup that results from an allergy. A kind of bacterial croup called *acute epiglottitis* can develop into a life-threatening blockage of the air passages within hours. Doctors treat this condition with antibiotics and perform an intubation or tracheotomy if necessary. Another bacterial infection causes *diphtheria,* also called *membranous croup,* a severe disease in which a membrane forms over the air passages. Neil R. Blacklow

See also **Diphtheria**.

Crow is a type of large, black bird that lives in all parts of the world except Antarctica, New Zealand, and South America. Crows belong to the crow family, which also includes jays, ravens, magpies, rooks, and jackdaws. The



Karl Maslowski, Photo Researchers

The American crow is found in most parts of North America. Crows use different calls to communicate with one another.

American crow, also called the *common crow,* is a clever, alert bird that inhabits open areas, farmland, the edges of woodland, and parks throughout North America. It typically remains in the same region the year around. Only the northernmost populations of these crows migrate south for the winter.

The American crow measures about 17 to 21 inches (43 to 53 centimeters) long. It has glossy, black feathers and a strong, sharply pointed bill. Bristly feathers cover the nostrils and the base of the bill. The bird's strong feet are well adapted for walking. Male and female American crows look alike, but the female is slightly smaller.

Crows do not have musical voices. However, they use more than 23 calls to communicate with one another. For example, when crows see or hear a predator, they call other crows with repeated long, loud notes. The crows then gather together to drive away the predator.

Crows build nests of sticks and bark in shrubs and trees, and sometimes on the crossarms of telephone poles. The female lays four or five bluish-green eggs with olive-brown spots. Both the male and female care for the young.

Crows eat a wide variety of foods. They annoy farmers by eating corn, wheat, and sorghum. However, they also feed on many kinds of insects and thus help limit insect damage to crops. Crows also eat spiders, small birds, eggs, rodents, and the flesh of dead animals.

Scientific classification. Crows belong to the crow family, Corvidae. The scientific name for the American crow is *Corvus brachyrhynchos.* Edward H. Burtt, Jr.

Related articles in *World Book* include:

Blue jay	Jay	Raven
Jackdaw	Magpie	Rook

Crow, Jim. See Jim Crow.

Crow Indians are a tribe of the northern Great Plains of the United States. About 4,000 of the tribe's members

live on the Crow Indian Reservation in southeastern Montana. The Crow have strong ties to this area, which they have occupied for at least 300 years.

The Crow conduct their official business through a tribal council made up of all adult members of the tribe. The council elects a chairman and other officers. The Crow work in agriculture, cattle ranching, tourism, and other occupations. The Crow hold several traditional ceremonies, including the annual sun dance and Crow Fair and Rodeo. Tobacco-planting ceremonies, the sun dance, Christianity, and use of the drug peyote play an important part in their religion.

The Crow were originally farmers. They were once part of another Plains tribe, the Hidatsa, along the Missouri River in what is now North Dakota. About the early 1700's, the Crow moved westward and hunted buffalo on the northern plains. The people lived in tepees and moved often to follow the buffalo herds. The Crow called themselves the *Apsáalooke,* which means *children of the large-beaked bird.* They became wealthy horse traders and produced fine craftwork.

The Crow were frequently at war with neighboring tribes, including the Blackfeet and the Sioux. But they quickly became friends with the white settlers and soldiers. In 1825, the tribe signed a friendship treaty with the United States government. The government established the Crow reservation through a series of treaties that began in 1851. Peter Nabokov

See also **Indian, American** (Indians of the Plains; picture: Shield covers).

Crowfoot. See **Buttercup.**

Crowfoot (1830-1890), a Canadian Blackfoot Indian chief, prevented his people from joining the North West Rebellion against the Canadian government. The advance of white settlers into the Saskatchewan region disturbed many Indians. But Crowfoot realized that resistance would be foolish because the whites were so powerful. Government promises of food and other assistance to the Blackfoot helped influence Crowfoot to decide against joining the uprising.

Crowfoot was born in southern Alberta. His Indian name was Isapomuxika. As a young man, Crowfoot became a noted warrior known for his bravery and scouting abilities. But he later urged his people to stop fighting the whites and other Indians. In 1866, Crowfoot became head chief of the Blackfoot. He settled on a reservation in 1877. Hartwell Bowsfield

See also **North West Rebellion.**

Crown is a circular ornament worn on or around the head as a symbol of authority, merit, or distinction. A royal crown is a king's or queen's symbol of supreme authority but is generally worn only on state occasions. Most such crowns are made of gold, engraved, and ornamented with precious gems.

The British royal crown consists of a gold band studded with diamonds, pearls, and other precious stones. From the band rise crosses, fleurs-de-lis, and four arches, topped by a jeweled gold cross. The crown of the British ruler is regarded to be priceless (see **Gem** [picture]; **Elizabeth II** [picture]). A few crowns made for princes in India have famous, valuable jewels.

The Crown is a term often used for a monarch in his or her official capacity. It also means a monarch's rule, position, or empire, of which the crown is a symbol.





© Lee Boltin

Historic crowns include the Crown of the Andes, *left,* from Peru, and the Imperial Russian Nuptial Crown, *right.*

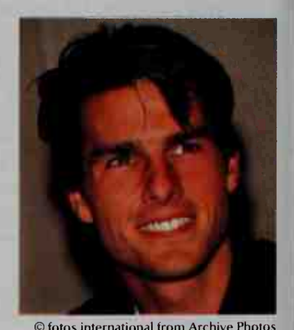
The history of crowns. Various jeweled headdresses were worn by rulers of ancient Egypt and Assyria. The Greeks gave a crown or diadem of olive leaves to their athletes as a symbol of victory. Later the Romans adopted this custom. Their crowns were made of metal, usually gold, and were worn by the Roman emperors. From the reign of Constantine (306-337), the diadem was regarded as the symbol of royal power. Later European rulers probably borrowed the practice of wearing a crown from the Romans.

Iron Crown of Lombardy was worn by the Lombard kings and later by the emperors of the Holy Roman Empire, who were also kings of the Lombards. It is made of gold, decorated with jewels and cloisonné enamel. Its name comes from an inner iron circlet which tradition says was beaten from a nail of the cross of Christ. Artisans probably made it in the A.D. 500's. Charlemagne, Emperor Charles V of the Holy Roman Empire, and Napoleon I wore the Iron Crown. It is in the Cathedral of St. John the Baptist at Monza, Italy. Whitney Smith

Crucifixion. See **Jesus Christ** (The Crucifixion).

Cruikshank, *KRUK shangk,* **George** (1792-1878), an English artist, became famous for his caricatures and illustrations. His more than 5,000 works range from caricatures to illustrations and historical paintings. He worked closely with Charles Dickens to produce the illustrations for *Oliver Twist.* For examples, see **English literature** and **Dickens, Charles.** Cruikshank also illustrated books by such writers as Oliver Goldsmith, Henry Fielding, and Miguel de Cervantes. He also gained praise for his series of drawings on the evils of drunkenness. He was born in London. His father, Isaac Cruikshank, was a noted political caricaturist. Charles P. Green

Cruise, Tom (1962-), is a popular American motion-picture star known for his striking good looks and self-confident manner. Since the mid-1980's, Cruise's enormously profitable films have made him one of the superstars of his generation.



© fotos international from Archive Photos

Tom Cruise

Thomas Cruise Mapother IV was born in Syracuse, New York. He began acting while still in high school. Cruise made

his film debut in *Endless Love* (1981). His handsome appearance and confident style led to several juvenile roles in the 1980's, notably in *Taps* (1981) and *The Outsiders* (1983). Cruise's first major success was in the coming-of-age comedy *Risky Business* (1983). He became a star in the military drama *Top Gun* (1986).

Eager to appear in a broad range of roles, Cruise played offbeat characters in such movies as *The Color of Money* (1986), *Born on the Fourth of July* (1989), and *Interview with the Vampire* (1994). His other films include *Rain Man* (1988), *A Few Good Men* (1992), *The Firm* (1993), *Mission: Impossible* (1995), *Jerry Maguire* (1996), *Eyes Wide Shut* (1999), *Magnolia* (1999), *Mission: Impossible 2* (2000), *Vanilla Sky* (2001), and *Minority Report* (2002). Louis Giannetti

Cruise ship is a ship designed to provide an enjoyable vacation experience as it carries passengers to one or more destinations. A modern cruise ship is huge, and it may hold 3,000 or more passengers and crew. Besides guest rooms, cruise ships have restaurants and shops, and many feature spas, fitness centers, swimming pools, theaters, and casinos. Some even feature water slides.

Cruise ships operate all over the world. Popular cruise destinations include Alaska, the Caribbean, and the Mediterranean. In Europe, cruise ships often depart from ports in Italy and Greece. When a cruise ship comes into a port, guests may make excursions into the city or take tours to sites in the country.

The operation of cruise ships began in the early 1900's, when large ocean liners provided passage across the Atlantic Ocean between Europe and North America. The ocean liners of the 1930's were among the most luxurious ever made. They provided magnificent staterooms and fine dining to members of high society on the upper decks, and less expensive room and board to passengers on the lower decks. Carl Braunlich

See also **Ship** (Ocean liners).

Cruiser is a large warship used to escort aircraft carriers and for independent operations with destroyers. Modern cruisers, called *guided missile cruisers,* can fire missiles, rockets, and torpedoes. Some can also carry helicopters. Cruisers use radar, sonar, and electronic intercept equipment to detect enemy aircraft, surface ships, and submarines. Most cruisers have gas turbine engines. Some have nuclear reactors that provide steam power. Cruisers can travel at a speed of about 30 knots (nautical miles per hour).

United States Navy cruisers built in the 1980's and 1990's belong to the *Ticonderoga* class. They are about 565 feet (170 meters) long, and they have an advanced radar and weapon control system known as AEGIS.

In World War II (1939-1945), cruisers fought enemy ships and bombarded beaches in support of amphibious landings. After the war, the U.S. Navy built large destroyer-type ships to escort aircraft carriers. These ships were called *frigates* until 1975, when the Navy renamed them guided missile cruisers. That year, the Navy also decommissioned its last all-gun cruiser. Norman Polmar

See also **Frigate**.

Crumb, George (1929-), is an American composer known for his innovative and highly individual works. Crumb received the Pulitzer Prize for music in 1968 for his orchestral work *Echoes of Time and the River* (1967). This work incorporates elements of theater. Instrumentalists are asked to march and to whisper and shout various short phrases and magical incantations. In the third *movement* (section), a xylophone taps out Crumb's name in Morse code.

Among Crumb's important works are vocal compositions based on poems by Federico García Lorca of Spain. They include four books of *Madrigals* (1965-1969), *Songs, Drones, and Refrains of Death* (1969), and *Ancient Voices of Children* (1970). The work is written for soprano, boy soprano, and an ensemble including percussion instruments, musical saw, and amplified harp and piano. The trio *Vox Balanae (Voice of the Whale,* 1971) consists of an electronically amplified cello, flute, and piano played by musicians wearing masks. This composition was inspired by Crumb's hearing recorded sounds of a whale. *Makrokosmos* (1972) is an important collection of piano studies. In 2001, Crumb won a Grammy Award for his composition *Star-Child* (1999). He was born on Oct. 24, 1929, in Charleston, West Virginia. Stephen Jaffe

Crusades were Christian military expeditions and religious wars proclaimed by the pope. They were organized mainly to defend Christians and to recover or defend territories that Christians believed belonged to them by right. The Crusades, waged by Western Europeans, took place from the late 1000's to the 1500's. The original goal of the Crusades was to gain and keep control of Palestine, also called the Holy Land. This region was important to Christians because it was where Jesus Christ had lived. Palestine lay along the eastern coast of the Mediterranean Sea, and Muslims had taken control of it from Christians. In the First Crusade, Christians recaptured Palestine. During later Crusades, they fought to protect Palestine or to recover parts of it that had again been lost to Muslim forces.

According to the church, crusading counted as an *act of penance*—that is, payment to God for sins committed. From the late 1000's to the late 1300's, the Crusades were a popular religious activity, attracting thousands of nobles, knights, peasants, and townspeople. Not all the crusaders joined the expeditions for religious reasons. Some hoped to gain power, territory, and riches. But most survivors returned home with little material profit.

Even after 1291, when Muslims regained control of the last Christian territory in Palestine, Crusades continued in the eastern Mediterranean region. They also took place in such areas as the Iberian Peninsula, the lands surrounding the Baltic Sea, Eastern Europe, and even within Western Europe itself. The crusaders' enemies included Muslims and other non-Christians, Greek and Russian Orthodox Christians, and even Roman Catholics considered to be political threats to the church.

The word *crusade* comes from the Latin word *crux,* meaning *cross.* Members of the many expeditions sewed the symbol of the cross of Christ on their clothing. "To take up the cross" meant to become a crusader.

How the Crusades began. During the A.D. 500's, the Byzantine Empire—a Christian empire centered in southeastern Europe—controlled much of the land bordering the Mediterranean Sea. This area included southeastern Europe, Asia Minor (now part of Turkey), Palestine, Syria, Italy, and parts of Spain and North Africa. In the 600's, Arab Muslims conquered Palestine, including Jerusalem. Most of the new Arab rulers allowed Christians to visit the shrines in the Holy Land.

Starting in the 900's, Christian pilgrimages from Western Europe to Palestine became increasingly common, and the attachment of Western Christians to a place they considered to be holy grew. Christians came to believe it was a disgrace that Muslims controlled the sites of Christ's crucifixion and resurrection.

During the 1000's, Seljuk Turks from central Asia conquered Asia Minor, Palestine, and Syria. The Seljuks, who were Muslims, crushed the Byzantines in the Battle of Manzikert in Asia Minor in 1071.

In 1095, Byzantine Emperor Alexius Comnenus asked Pope Urban II for assistance in fighting the Seljuk Turks. Urban agreed to help. He wanted to defend Christianity against the Muslims and to recover the holy places.

In the autumn of 1095, Urban held a meeting of church leaders in Clermont, France. At this Council of Clermont, Urban called for a crusade. He gave a stirring sermon, urging European Christians to stop fighting among themselves and recapture the Holy Land from the Muslims. He promised the crusaders both spiritual and material rewards for their work. The crowd reportedly responded with shouts of "God wills it!" An intense desire to fight for Christianity gripped Western Europe, and thousands of people joined the cause.

The First Crusade (1096-1099). Following Urban's call for a crusade, a preacher known as Peter the Hermit and a knight called Walter the Penniless led groups that rushed ahead of the official expedition. These crusaders made up the first of several untrained and undisciplined groups that became known as the Peasants' Crusade. They demanded free food and shelter as they traveled through eastern Europe toward Constantinople (now Istanbul, Turkey). Stirred by an intense feeling against non-Christians, some groups in the Peasants' Crusade—and some later crusaders—also killed many Jews. Because the members of the Peasants' Crusade often stole what they wanted, many were killed by angry Europeans. Muslims killed most of the rest in Asia Minor.

The main armies sent by Urban consisted chiefly of well-trained French and Norman knights. The key leaders included Godfrey of Bouillon, Raymond of Toulouse, Robert of Flanders, Robert of Normandy, Stephen of Blois, and Bohemond of Taranto. At Constantinople, Byzantine forces joined the crusaders. In 1097, the combined army took the city of Nicaea, in what is now northwest Turkey.

Then the army divided, and the Western Europeans marched toward Jerusalem, fighting many bloody battles along the way. The most difficult was the siege of Antioch, in northern Syria (now in Turkey). Many crusaders died there, in battle or from hunger, and many others deserted. After Antioch had been captured, the crusaders were attacked there by the Seljuks. However, the crusaders discovered a lance said to be the one that was thrust into the side of Jesus on the cross. Inspired by this discovery, the crusaders won a great victory. The Europeans arrived at Jerusalem in the summer of 1099. They recovered the city after six weeks of fighting. Most of the crusaders then returned home. The leaders who stayed divided the conquered land into four crusader states—the County of Edessa, the Principality of Antioch, the County of Tripoli, and the Kingdom of Jerusalem.

The Second Crusade (1147-1149). In 1144, the Turks conquered the County of Edessa. The threat to the other crusader states brought about the Second Crusade. The spirited preachings of the French religious leader Bernard of Clairvaux inspired Western Europeans to defend the crusader states against the Muslims.

King Louis VII of France and King Conrad III of Germany led the armies of the Second Crusade into Asia Minor. But their armies did not cooperate, and the Muslim forces defeated them before they reached Edessa.

The Third Crusade (1189-1192). The Muslims continued to attack the Christians in the Holy Land. By 1183, Saladin, the sultan of Egypt and Syria, had united the Muslim areas around the crusader states. In 1187, Saladin easily defeated a Christian army at the Battle of the Horns of Hattin and triumphantly entered Jerusalem. Only the coastal cities of Tyre, Tripoli, and Antioch remained in Christian hands.

The loss of Jerusalem led to the Third Crusade. The important European leaders of the Third Crusade included the German emperor Frederick I (called Barbarossa), King Richard I (the Lion-Hearted) of England, and King Philip II (Augustus) of France.

Frederick drowned in 1190 on his way to the Holy Land. Quarrels among Richard, Philip, and other leaders limited the crusaders' success. The Europeans conquered the Palestinian port cities of Acre (now Akko) and Jaffa in 1191. But after the capture of Acre, Philip returned home. Richard tried to recapture Jerusalem. He failed, but his recovery of the Palestinian coastline allowed the Kingdom of Jerusalem to exist for another century. Before Richard left for home, he negotiated a

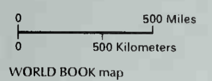

Bruno Barbey, Magnum



A crusader's fortress, Krak des Chevaliers, was built powerfully to withstand Muslim attacks. This castle, which stands in Syria on the site of small, earlier fortifications, was rebuilt and expanded by the Knights Hospitallers in the 1100's and 1200's. Such fortresses could house several thousand fighting men and their servants.

First and Third crusades

This map shows where the First and Third crusades started and the routes the crusaders followed to the Holy Land. The First Crusade began in 1096 and ended in 1099. The crusaders succeeded in capturing Jerusalem. They also established the crusader states: Edessa, Antioch, Tripoli, and Jerusalem. The Third Crusade began in 1189 and ended in 1192. The crusaders failed to recapture Jerusalem. But they recovered the coast and won an agreement with the Muslims to permit Christians to visit Jerusalem.



WORLD BOOK map



treaty with Saladin. As a result of this treaty, the Muslims let Christian pilgrims enter Jerusalem freely.

The Fourth Crusade (1202-1204). Crusading reached the height of its popularity in the 1200's. There was hardly a year during the century when crusaders were not fighting somewhere. The Fourth Crusade, which took place at the beginning of the 1200's, resulted from the failure of the Third Crusade to recapture Jerusalem. The crusaders became involved in affairs of the Byzantine Empire, however, and failed to reach their original goal.

Pope Innocent III persuaded many French nobles to take part in the Fourth Crusade, which he thought should go to the Holy Land. But the Crusade's leaders decided to attack Egypt instead in order to split Muslim power. The crusaders bargained with traders from Venice, a powerful Italian port city, to take them by ship to Egypt. Only about a third of the expected number of crusaders arrived at Venice, and they could not pay the costs of the ships. But the Venetians offered to transport the crusaders if they helped attack Zara, a city in what is now Croatia. The crusaders accepted the offer.

Meanwhile, a refugee Greek prince named Alexius claimed that his father, Isaac, was the rightful Byzantine ruler. The crusaders agreed to help him regain the empire in return for money and other aid in reconquering the Holy Land. In 1203, they camped outside Constantinople, briefly tried to capture the city, and made Isaac and Alexius co-emperors. But Alexius could not fulfill his promises to the crusaders. In 1204, the crusaders captured Constantinople and put Count Baldwin of Flanders on the Byzantine throne. This Latin Empire of Constantinople lasted until 1261.

The Children's Crusade (1212) was one of a number of People's Crusades—popular crusades that were not proclaimed by the pope and in which most of the crusaders were poor people. The Children's Crusade began after thousands of poor people, including boys and girls from about 10 to 18 years old, became convinced that they could recover Jerusalem. They believed God would deliver the Holy City to them because they were poor and faithful. Children from France formed one part of the group, and children from Germany the other. They expected God to part the waters of the Mediterranean Sea so that they could cross safely to Jerusalem.

None of the children reached the Holy Land. Many starved or froze to death during the long march south to the Mediterranean. When the expected miracle did not occur, some of the youngsters who survived the terrible journey to the sea got aboard ships going to the East. These children either were drowned in storms at sea or sold into slavery by the Muslims.

Other Crusades continued in the 1200's. In the Fifth Crusade (1217-1229), the Christians continued the strategy of concentrating their efforts on Egypt, which they considered to be a key for winning Palestine. They captured the port of Damietta, but soon had to give it up in exchange for a truce. The Emperor Frederick II of the Holy Roman Empire later negotiated a peace with the Muslim sultan, who gave Jerusalem to the Christians.

Jerusalem remained Christian until the Muslims seized it again in 1244. The fall of Jerusalem caused King Louis IX of France (Saint Louis) to lead a Crusade from 1248 to 1254. Like earlier crusaders, he also tried to win the Holy Land by attacking Egypt. But his expedition became disorganized, and the Muslims captured Louis and most of his army. The Muslims freed them in exchange for a ransom and the return of Damietta, which Louis had captured. Before returning to France, Louis spent four years in the Holy Land trying to strengthen the Christian forces there. In 1270, he led another Crusade against the Muslims. He landed his army at Tunis, in northern Africa. But he died soon afterward when disease broke out among his troops.

Meanwhile, in the East, the Muslims continued to gain Christian territory. They captured Antioch in 1268. Finally, in 1291, they seized Acre, the last Christian center in Palestine.

Concern about recovering the Holy Land remained strong in the 1300's. But in that century, the Ottoman Turks, who were Muslims, became a serious threat to Christian Europe. The crusaders shifted their attention from the recovery of Jerusalem to the defense of Europe. The Byzantine Empire fell to the Ottomans in 1453, and by 1500, Muslims were occupying far more territory

in Europe than the Christians had held in the East. But the crusaders did succeed in defending much of Western Europe from the Muslims and in recapturing Spain and Portugal from them. In the 1600's, Western Europeans began to recover parts of southeastern Europe.

Results of the Crusades. The crusaders failed to accomplish their main goals. They recaptured the Holy Land for a time but could not establish lasting control over the area. Western European and Eastern European Christians united to fight the Muslims. But relations between the Christians of Western Europe and the Orthodox Christians of the East became bitter. The Fourth Crusade, during which Western crusaders captured and partially destroyed Constantinople, played a major role in driving the two groups apart. Some bitterness has continued to the present day. In addition, the crusaders' persecution of European Jews marked the beginning of a long period of Jewish *martyrdom* (death for a belief).

But the Crusades also enriched European life. For example, they stimulated economic growth by increasing trade between cities bordering the Mediterranean Sea. The Italian cities of Venice, Genoa, and Pisa profited by carrying crusaders and supplies to the Middle East. These cities gained trading privileges in territories conquered during the Crusades. The cities became rich and powerful handling trade in Asian goods that passed through the conquered territories on the way to Europe.

Western Europeans also learned how to build better ships and make more accurate maps during the Crusades. They began to use magnetic compasses to tell directions. The Crusades were only modestly important compared to the great commercial expansion or the rise of monarchies in Western Europe. But they seemed extremely important to the people of the crusading era.

Historians once thought the crusaders who returned to Europe introduced Westerners to Eastern goods and ways of life. They thought that this contact greatly influenced Western life. As a result of the Crusades, they argued, Europeans were introduced to such items as sugar, silk, velvet, and glass mirrors. But modern historians reject these arguments. They point to a wide amount of interchange between Muslims, Byzantines, and Europeans long before the Crusades. Jonathan Riley-Smith

Related articles in *World Book* include:

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Flag (pictures: Historical flags of the world)
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Heraldry (The development of heraldry)
Innocent III
Jerusalem
Jews (Jews in Christian Europe)
Knights and knighthood
Knights Hospitallers
Knights Templars
Louis IX
Muslims
Philip II
Richard I
Saladin
Teutonic Knights
Urban II

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Crusoe, Robinson. See Robinson Crusoe.

Crustacean, *kruhs TAY shuhn,* is an invertebrate animal with many jointed legs and a hard external shell. A crustacean has no bones. The external shell, called an *exoskeleton,* covers and protects the body. Crabs, crayfishes, lobsters, and shrimp are crustaceans, as are barnacles, water fleas, and wood lice.

There are more than 42,000 species of crustaceans. The largest species, the giant spider crab of Japan, measures up to 12 feet (3.7 meters) long between its outstretched claws. The smallest crustaceans, such as copepods and water fleas, may be less than $\frac{1}{24}$ inch (1 millimeter) long. Most crustaceans live in salt water, but some inhabit fresh water. A few species, including certain crabs and wood lice, live on land.

Crustaceans play a major role in *aquatic* (water) ecology. In most aquatic environments, small, floating organisms that make up the *phytoplankton* are the basic food producers (see **Plankton**). These organisms produce food from light by means of photosynthesis. Many small crustaceans feed on phytoplankton. These crustaceans then are eaten by larger crustaceans, fish, and even baleen whales. Crustaceans thus form an important link between the small food-producing organisms and the larger animals in the aquatic food chain.

People in many parts of the world eat lobsters, shrimp, and other crustaceans. On the other hand, some kinds of crustaceans cause problems for people. For example, certain aquatic wood lice burrow into, and eventually destroy, wooden wharves. Barnacles attach themselves to the hulls of ships and greatly reduce the vessels' speed. In some tropical regions where farms are near the sea, certain crabs and other crustaceans harm crops by burrowing into and damaging dikes that surround the fields or by eating the young plants.

The body of a crustacean

Outer body. The body of an adult crustacean typically has three main parts, each of which consists of many segments. These three parts are (1) the head, (2) the thorax, and (3) the abdomen.

The head of a crustacean has two pairs of antennae, a pair of eyes, and three pairs of accessory mouthparts. The eyes may be level with the surface of the exoskeleton or at the ends of stalks. The head also includes the mouth and a pair of jaws.

Each segment of the thorax has a pair of legs. The two pairs of legs closest to the head have *pincers* (claws), which are used for catching food and bringing it to the mouth, for fighting, and for other activities. Crustaceans use their other legs mainly for walking or swimming. In some crustaceans, gills for breathing develop at the base of the legs.

The abdomen of a crustacean varies greatly in size and appearance, depending on the species. The abdomen of a lobster is large and muscular and extends from the thorax like a tail. The abdomen of a crab, on the other hand, is thin and is folded beneath the thorax. Some species of crustaceans, such as lobsters and shrimp, have leglike appendages on their abdomen. These appendages usually are tiny, and the animal uses them primarily in swimming. A crustacean's abdomen ends in a flattened, taillike structure called a *telson.* Some crustaceans snap the telson rapidly to swim backward.



Orion Press from Bruce Coleman Ltd.

Giant spider crab



© Edward S. Ross

Spiny lobster



© F. Stuart Westmorland, Tom Stack & Assoc.

Goose barnacles



© Paulette Brunner, Tom Stack & Assoc.

Copepod

Crustaceans are invertebrate animals with an external shell. There are more than 42,000 species of crustaceans. Most of them live in salt water. The above photographs suggest the great variety of types of crustaceans.

Internal organs. In large crustaceans, a heart pumps blood throughout the body. Arteries carry blood away from the heart. The blood drains into cavities in the lower parts of the body and then returns to the heart through special openings. Some of the smaller crustaceans, such as certain copepods, have no heart. Their body movements promote circulation of the blood.

A crustacean's digestive system has three main parts: (1) the foregut, (2) the midgut, and (3) the hindgut. A crustacean has no teeth, and so it cannot chew. Instead, plates and spikes of shell in the foregut grind up food. The food is then directed to the midgut or the hindgut. The midgut produces enzymes and other substances that help digest the food. The hindgut stores undigested materials until they are eliminated from the body through an opening called the *anus.*

Crustaceans have a simple brain. It is connected to a nerve cord that extends along the underside of the body. Branches from the nerve cord enter each body segment and control various activities.

Most crustaceans breathe through gills. However, many small species have no gills. They breathe through their skin.

Senses. Most adult crustaceans have a pair of *compound eyes.* These eyes consist of many separate simple eyes. The entire group of eyes provides the crustacean with a mosaic image and can detect movement (see **Compound eye**). Adult copepods and a few other species of crustaceans have only *simple eyes,* which sense light but do not form an image.

Tiny hairlike *setae* cover various parts of the exoskeleton. Certain of them are sensitive to taste and touch. These sensory setae are concentrated on the antennae, mouthparts, and pincers.

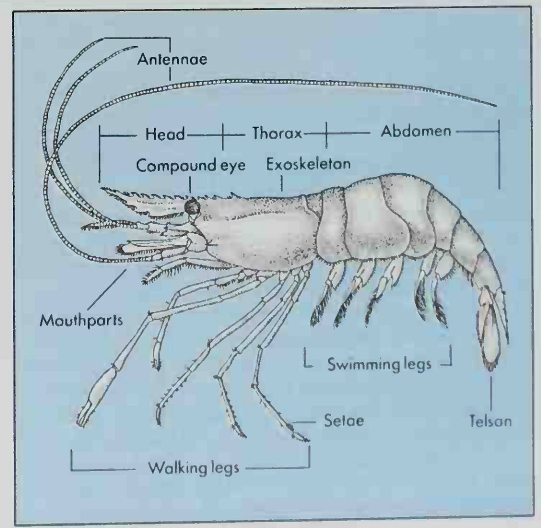
The life of a crustacean

Reproduction. Among crustaceans, a new individual is created when a sperm of the male fertilizes the egg of a female. The male may deposit sperm on the female's shell or into sperm receptacles on her abdomen. The sperm then fertilize the eggs as the female lays them. The number of eggs produced at one time varies tremendously among species. The crayfish lays from about 50 to 150 eggs. The Chinese wool-handed crab produces as many as 900,000 eggs at a time. In most species of crustacean, the female carries the eggs on the abdomen and protects them until they hatch.

The body of a crustacean

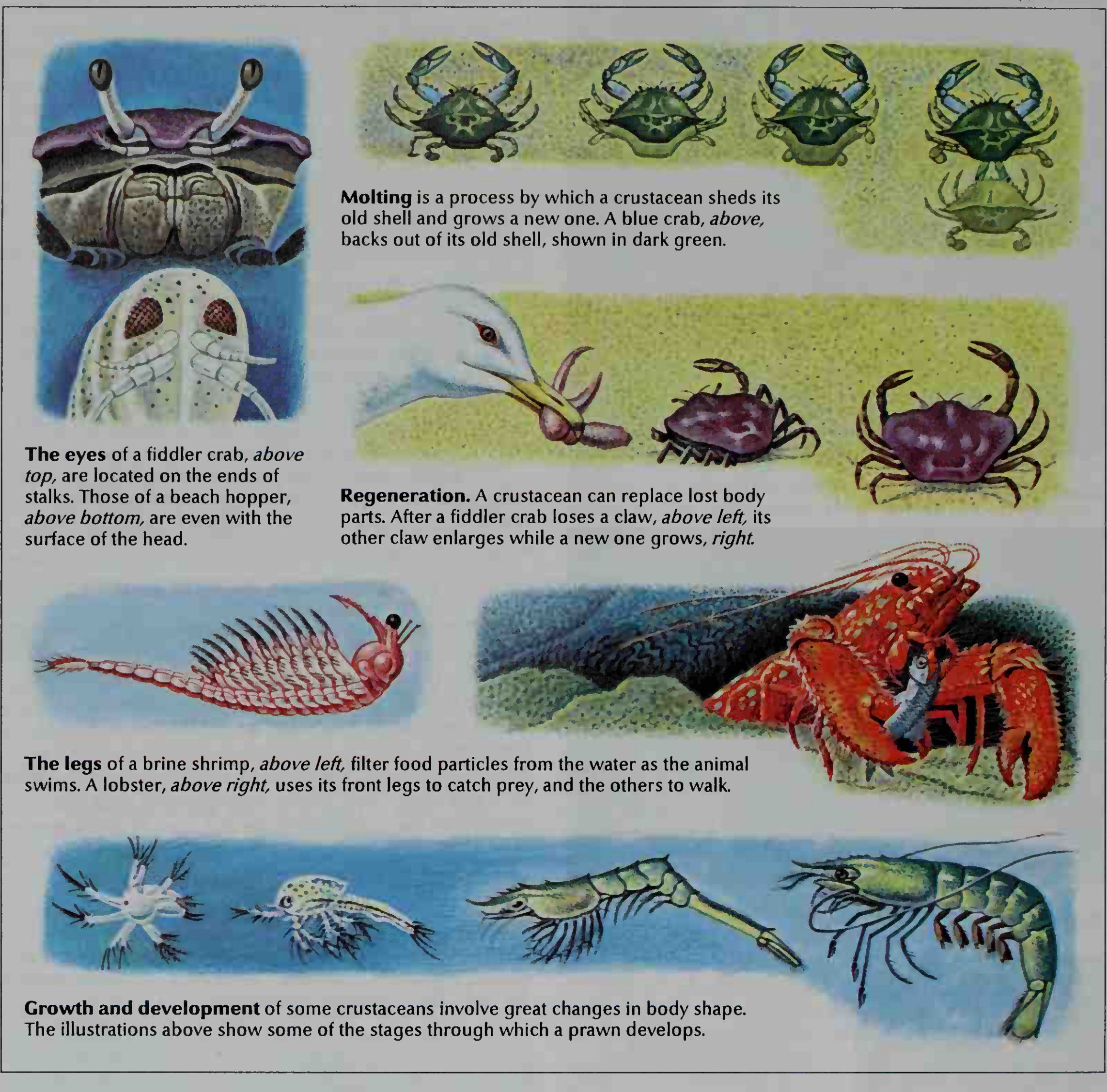
A crustacean's body has three main parts: head, thorax, and abdomen. The animal's hard shell, called the *exoskeleton,* protects the body. The crustacean pictured below is a shrimp.

WORLD BOOK diagram by Patricia J. Wynne



Interesting facts about crustaceans

WORLD BOOK illustrations by James Teason



Molting is a process by which a crustacean sheds its old shell and grows a new one. A blue crab, *above,* backs out of its old shell, shown in dark green.

The eyes of a fiddler crab, *above top,* are located on the ends of stalks. Those of a beach hopper, *above bottom,* are even with the surface of the head.

Regeneration. A crustacean can replace lost body parts. After a fiddler crab loses a claw, *above left,* its other claw enlarges while a new one grows, *right.*

The legs of a brine shrimp, *above left,* filter food particles from the water as the animal swims. A lobster, *above right,* uses its front legs to catch prey, and the others to walk.

Growth and development of some crustaceans involve great changes in body shape. The illustrations above show some of the stages through which a prawn develops.

Growth and development. Most crustaceans hatch from the egg in an immature form known as a *larva.* At first, the larva does not look at all like the adult animal. The larva swims weakly in the sea for several weeks. During this time, it gradually changes form, adding new body segments and appendages until it looks like its parents. A few species of crustaceans, including beach hoppers and wood lice, have no larval stage. The young of these species hatch as miniature adults.

A crustacean's exoskeleton does not expand, and so the growing animal repeatedly sheds its old shell and grows a new, larger one. The shedding process is called *molting.* Many species of crustaceans continue to molt throughout life, but others stop after reaching maturity. Before molting begins, the crustacean absorbs some of the nutrients from its old shell. It uses these nutrients to form a soft, thin new exoskeleton beneath the old shell. The old exoskeleton then splits, and the animal works its way out of it. The crustacean takes in water and swells to a larger size before the new shell hardens. A crustacean's muscles are connected to its shell. During molting, muscle attachments to the old shell are broken, and the animal has difficulty moving about. Until the new shell hardens, the animal often hides in a crevice or a small underwater cave.

If certain parts of a crustacean's body are damaged or lost, they may be repaired or replaced through a process called *regeneration.* The replacement part may appear during the next molt in a reduced size and then gradually enlarge to full size with successive molts. Some crustaceans, such as crabs and lobsters, can voluntarily detach a limb that has been caught by an enemy.

Food and habits. A few species of crustaceans live as parasites on other animals. Other species, including crabs, crayfishes, and lobsters, prey on various water

creatures or eat the remains of animals and plants. Certain species, such as water fleas and some copepods, as well as many crustacean larvae, drift through the water and feed on floating microorganisms. In turn, these crustaceans are eaten by barnacles, krill, and other crustaceans, and by many kinds of fish. Krill are eaten by baleen whales, fish, and birds. Various other crustaceans become the prey of birds and land mammals.

Crustaceans live in a wide variety of habitats. Some drift in the water as part of the plankton. Others prowl along the shore of a body of water and hide among rocks or weeds. Some find shelter in a sponge or coral, or inside an abandoned shell of a snail. Crabs and some other crustaceans burrow into mud or sand for safety. Barnacles attach themselves to rocks along the seashore as well as to turtles, whales, ships, and wharves. Most land crustaceans live under rocks or in burrows, rotting wood, or other damp places. Jonathan Green

Scientific classification. Crustaceans make up the subphylum Crustacea in the phylum Arthropoda. Crabs, crayfishes, lobsters, shrimp, and wood lice belong to the class Malacostraca. Barnacles make up the class Cirripedia. Copepods make up the class Copepoda. Water fleas belong to the class Branchiopoda.

Related articles in *World Book* include:

Arthropod	Crab	Hermit crab	Shrimp
Barnacle	Crayfish	Krill	Water flea
Blue crab	Fiddler crab	Lobster	Wood louse
Copepod			

Cryobiology, *KRY oh by AHL uh jee,* is the study of how extremely low temperatures affect living things. Cryobiologists use temperatures that range from 32 °F (0 °C), the freezing point of water, down to just above −459.67 °F (−273.15 °C), which is absolute zero (see **Absolute zero**). The word *cryobiology* comes from the Greek *kryos* (cold) and *biology* (science of living things).

Cryobiologists are chiefly concerned with freezing living matter to preserve it for future use. The freezing must be done to keep the cells alive. Cryobiologists use a liquid gas, usually nitrogen, to obtain temperatures far below normal freezing. Cells kept cold in the gas stop working. But they stay alive and unchanged in a state of "suspended animation." They can remain in this state without harm for long periods. After thawing, the cells resume their normal work almost at once. Cryobiologists are experimenting with a technique called *vitrification* to preserve living cells that are normally damaged by other freezing techniques. Vitrification involves cooling specimens into glasslike solids using solutions that prevent ice crystals from forming.

The freezing of blood and tissues such as corneas and skin makes it possible to store these parts in "banks." Doctors may use skin from such a bank to graft onto a badly burned patient. They use stored corneas to replace diseased or damaged ones. Frozen red blood cells can be stored for many years. Frozen sperm, eggs, and embryos are commonly used for animal breeding and sometimes for human *in vitro fertilization* (see **Infertility** [Treatment]).

In *cryosurgery,* surgeons use extreme cold to destroy diseased tissue. For example, surgeons can perform a "bloodless" operation using instruments equipped with *freezing tips.* David Mason Robinson

Cryogenics, *KRY uh JEHN ihks,* is the study of extremely low temperatures. It includes the development of techniques that produce and maintain such temperatures for industrial and scientific use. Temperatures of primary interest in cryogenics range from about −184 °F (−120 °C) to almost *absolute zero,* −459.67 °F (−273.15 °C). Absolute zero is, theoretically, the lowest temperature a gas can reach. Cryogenic temperatures are usually given on the *Kelvin scale,* the standard for scientific temperature measurement. Absolute zero has a value of zero on the Kelvin scale.

The word *cryogenics* comes from two Greek words meaning *cold* and *produce.* Physicists first produced extremely cold temperatures in the 1870's with the development of *liquid air* (see **Liquid air**).

In 1963, scientists cooled copper nuclei to the lowest temperature reached so far—almost one millionth Kelvin above absolute zero. The nuclei were magnetized at low temperatures in a magnetic field. When the magnetic field was removed, the nuclei became demagnetized and their temperature dropped to near absolute zero.

The first industrial use of cryogenics was the production of liquid air, a primary source of liquid oxygen and liquid nitrogen. Certain aircraft and spacecraft carry liquid oxygen that can be converted into gaseous form for crews to breathe on long flights. Other uses of liquid oxygen include the manufacture of synthetic gases and the treatment of waste water. Liquid oxygen and liquid hydrogen are also used in some rocket propellants and in fuel cells. Liquid nitrogen serves as a refrigerant. In addition, industry uses cryogenic techniques in the liquidizing, transportation, and storage of natural gas and the freezing, transportation, and storage of food.

Cryogenics has provided physicians with ways to freeze living parts of the body, such as blood and eye corneas, for future use. Other medical uses of cryogenic techniques include freezing organs during operations and destroying diseased tissue (see **Cryobiology**).

In physics research, the development of the liquid hydrogen bubble chamber provided a major tool for the study of subatomic particles. Processing at cryogenic temperatures has made isotope-separation techniques more efficient for nuclear energy research. Cryogenics also contributed to the discovery of *superconductivity,* the ability of some materials to conduct electric current with no resistance at temperatures near absolute zero. Superconducting magnets cooled with liquid helium are used in medicine in *magnetic resonance imaging* (MRI), a technique that produces images of the internal organs of the body (see **Magnetic resonance imaging**).

Alan F. Clark

See also **Absolute zero; Refrigeration** (Low-temperature refrigeration); **Superconductivity.**

Cryosurgery. See Cryobiology; Surgery (Technique).

Crypt, *krihpt,* is an underground room or vault. It usually refers to a vault under a church. The word comes from the Greek *kryptein* (to hide). Saints and martyrs were often buried in crypts. Chapels and altars were sometimes built over the spot where their bones were supposed to lie. One famous crypt is that of Saint Helena in Jerusalem. Legend says she found there the cross on which Christ died. Other famous crypts include those of Saint Peter's in Rome, of Saint Nicholas at Bari, of Canterbury Cathedral, and of Glasgow Cathedral.

Stanley K. Stowers

See also **Altar; Catacombs.**

Cryptology. See Codes and ciphers.
Crystal. See Glass.
Crystal is a solid that is composed of atoms arranged in an orderly pattern. Most nonliving substances are made up of crystals. For example, metals and rocks consist of crystals, as do snowflakes, salt, and sugar.

Well-developed crystals have a distinctly regular shape as a result of the orderly arrangement of atoms. Such crystals have smooth, flat surfaces, which intersect to form sharp edges. These surfaces, called *crystal faces,* show definite geometrical relationships. For example, the faces of crystals of the same substance always meet at the same angle regardless of the shape and size of the crystals.

The scientific study of crystals is called *crystallography.* Crystallographers measure angles between crystal faces and analyze arrangements of such surfaces. They also examine atomic structures of crystals with the aid of *transmission electron microscopes* and *X-ray diffraction* techniques (see **X rays** [In crystal research]).

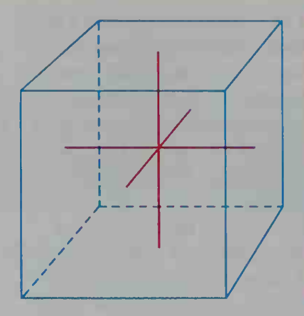
Crystallization is the process by which matter forms crystals. Crystals may form from vapors, solutions, or *melts* (molten materials). When either temperature or pressure is lowered or evaporation occurs, certain atoms in such substances move close together and join. In most cases, they do so on a *crystallization nucleus,* an impurity or a tiny piece of crystal consisting of a particle or cluster of atoms. The atoms collect on the nucleus and arrange themselves into structural units called *unit cells* to form a crystalline solid. A crystal grows by adding atoms to its surfaces in an expanding network of unit cells. See **Mineral** (Inside minerals).

In a few cases, crystals develop smooth, mirrorlike faces. Such crystals are said to be *euhedral.* Euhedral crystals grow only in a space where they cannot touch other crystals, so they rarely occur in nature. Most crystals are *subhedral*—that is, they have poorly formed faces that are rough or pitted. Some crystals, called *anhedral* crystals, have no faces at all. Most rocks are composed of anhedral crystals.

Classifying crystals. Crystals are classified according to *symmetry,* a balanced arrangement of faces. There are three basic types of crystal symmetry—plane of symmetry, axis of symmetry, and center of symmetry.

A *plane of symmetry* is an imaginary plane that divides a crystal into identical halves. An *axis of symmetry* is an imaginary straight line drawn through the center of a crystal. When a crystal is rotated 360° about this axis, there appear from two to six faces or arrangements of faces that cannot be distinguished from one another. For example, a line through the center of a cube parallel to the line of intersection of any two faces is an axis of symmetry. This axis is called a *fourfold* axis of symmetry because four identical faces appear during a 360° rotation of the cube. Most crystals have a *center of symmetry,* which means their opposite sides are identical.

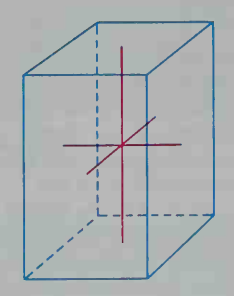
All crystals can be grouped into 32 combinations of symmetry. These combinations, in turn, can be classified into seven general crystal systems. These systems are (1) isometric, (2) tetragonal, (3) hexagonal, (4) rhombohedral, (5) orthorhombic, (6) monoclinic, and (7) triclinic. Each system may be described in terms of three imaginary axes, called *crystallographic axes,* which intersect in the center of a crystal.


Isometric crystal


Pyrite

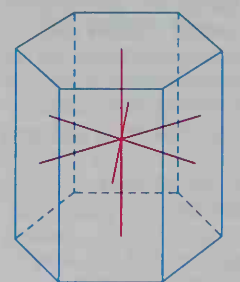
Isometric system. Crystals in this system have three axes of equal length that are perpendicular to one another. The simplest isometric crystal is a cube. Another form is the octahedron, which has eight sides consisting of equilateral triangles. Such minerals as galena, garnet, and pyrite crystallize in this system.

Tetragonal system. Tetragonal crystals have three axes that intersect at right angles. Two of the axes are of equal length. The simplest form of tetragonal crystal is a prism in which the sides are rectangular and the top and bottom are square. Other tetragonal crystals resemble eight-sided pyramids. Their sides are made up of identical *isosceles* triangles, which are triangles with two equal sides. The minerals cassiterite, rutile, and zircon crystallize in the tetragonal system.


Tetragonal crystal

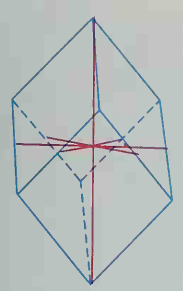

Rutile

Hexagonal system. Hexagonal crystals have four axes. Three of the axes are of equal length and lie in a horizontal plane with a 120° angle between one another. The fourth axis is perpendicular to the others and may be of any length. The simplest hexagonal crystal is a prism that has six rectangular faces parallel to the fourth axis. The

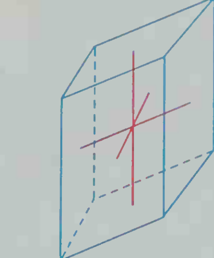

Hexagonal crystal


Field Museum of Natural History (WORLD BOOK photos)

Apatite


Rhombohedral crystal


Quartz

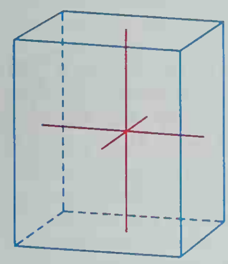

Triclinic crystal


Field Museum of Natural History (WORLD BOOK photos)

Plagioclase feldspar

minerals apatite, beryl, graphite, and molybdenite form in this system.

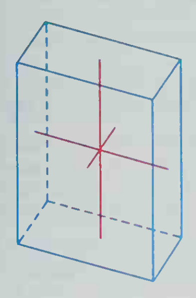
Rhombohedral system. Some crystallographers consider the rhombohedral system a subdivision of the hexagonal system because both systems can be defined in terms of the same axes. However, there is one major difference between them. The vertical axis of a rhombohedral crystal is a threefold symmetry axis, but that of a hexagonal crystal is a sixfold axis. The simplest crystal in the rhombohedral system has six rhomboidal faces, each consisting of an equal parallelogram. This system includes crystals of calcite, dolomite, and quartz.


Orthorhombic crystal


Barite

Orthorhombic system. Orthorhombic crystals have three axes of unequal length that intersect at right angles. The simplest crystal of this type is an orthorhombic prism with three sets of unequal rectangular faces that meet at right angles. Aragonite, barite, topaz, and certain other minerals crystallize in this system.

Monoclinic system. Monoclinic crystals have three axes of different lengths. Two of the axes are perpendicular to each other, but the third is inclined. A simple


Monoclinic crystal


Gypsum

monoclinic crystal has two rhomboidal faces and four rectangular ones. The top and bottom surfaces are inclined. Many compounds, including the minerals gypsum, hornblende, orthoclase, and pyroxene belong to this system.

Triclinic system. Triclinic crystals have three axes of unequal length. None of the axes are perpendicular. The faces of these crystals are all different and do not meet at right angles. Plagioclase feldspars and a few other minerals form in this system. William B. Simmons, Jr.

See also Gem; Mineral; Quasicrystal; Snow; Symmetry.

Crystal ball. See Fortunetelling.

Crystal set. See Radio (How radio programs are received; picture: A "crystal" radio).

Crystalline lens. See Eye (The uveal tract).

CT scan. See Computed tomography.

Ctenophore, *TEHN uh fawr,* is a small transparent sea animal that lives in all the oceans. Ctenophores are also called *comb jellies* and *sea walnuts.* The body of a ctenophore may be shaped like a ball, a thimble, or a belt. It looks somewhat like a jellyfish. The size of most *species* (kinds) varies from that of a pea to a thimble. One group of species, called *Venus's-girdle,* is shaped like a belt and may grow more than 3 feet (90 centimeters) long.

The word *ctenóphore* means *a comb bearer.* The animal gets this name from the eight bands of comblike organs on the sides of its body. The combs are made of groups of *cilia* (tiny hairlike structures). Ctenophores move slowly through the water by beating these cilia. In some species, the combs give off flashes of light.

P. A. McLaughlin

Scientific classification. Ctenophores make up the phylum Ctenophora.

Cuauhtémoc, *kwow TEHM ohk* (1495?-1525), was the last Aztec Indian ruler of Mexico. He defended the Aztec capital, Tenochtitlan (now Mexico City), against the Spanish conqueror Hernando Cortés. The city's fall in 1521 marked the end of the Aztec civilization.

Cuauhtémoc became ruler of the Aztec in 1520, four months after the death of his uncle, Emperor Montezuma II. In 1525, Cortés had Cuauhtémoc killed because he believed the Indian leader was plotting against the Spaniards.

Today, Mexicans honor Cuauhtémoc as a national hero because of his bravery in the defense of Tenochtitlan. Mexican Americans admire him as a symbol of their struggle for civil rights. Feliciano M. Ribera

Cub. See Bear; Lion; Tiger.

Cub Scout. See Boy Scouts.



Marice Cohn Band, © *The Miami Herald*

Cuba is a mountainous island in the West Indies. The beautiful Sierra Maestra range, *shown here,* on the southeast coast has played an important role in Cuba's history. It has served as a refuge for various rebel groups, including the one that brought Fidel Castro to power in the late 1950's.

Cuba

Cuba, *KYOO buh,* is an island nation that is the only Communist state in the Americas. It lies about 90 miles (145 kilometers) south of Key West, Florida. Havana is Cuba's capital and largest city.

Cuba is the largest island and one of the most beautiful islands in the West Indies. Towering mountains and rolling hills cover about a third of the island. The rest of Cuba consists mainly of gentle slopes and broad grasslands. Cuba has a magnificent coastline marked with deep bays, sandy beaches, and colorful coral reefs.

Cuba's geographic location has greatly influenced its history. The island lies at the intersection of major sea routes between the Atlantic Ocean, the Caribbean Sea, and the Gulf of Mexico. The famous explorer Christopher Columbus landed in Cuba in 1492, and the island later became an important strategic outpost of Spain's empire in the New World.

During the late 1700's and early 1800's, sugar cane became Cuba's single most important crop. Sugar cane was grown on large plantations that depended heavily on human labor. The desire for cheap labor for the plantations led to the importation of thousands of African slaves to Cuba.

During the 1800's, many Cubans began to call for independence from Spain. In 1898, the United States helped defeat Spain, which then gave up all claims to Cuba. A U.S. military government ruled Cuba from 1899 until 1902, when the island became a republic. But the United States maintained close ties with Cuba and often intervened in the island's internal affairs. During most of the period from the 1930's to the 1950's, Cuba was controlled by a dictator, Fulgencio Batista y Zaldívar.

In 1959, Fidel Castro led a revolution that overthrew Batista. The rebels later set up a Communist government, with Castro as its head. Relations between Cuba and the United States became tense soon after the revolution. The Castro government developed close ties with the Soviet Union, then the main rival of the United States in a struggle for international power. In 1961, the United States ended diplomatic relations with Cuba.

Louis A. Pérez, Jr., the contributor of this article, is J. Carlyle Sitterson Professor of History at the University of North Carolina at Chapel Hill. He has written extensively on Cuba.

Facts in brief

Capital: Havana.
Official language: Spanish.
Official name: República de Cuba (Republic of Cuba).
Area: 42,804 mi^2 (110,861 km^2). *Greatest distances*—northwest-southeast, 708 mi (1,139 km); north-south, 135 mi (217 km). *Coastline*—2,100 mi (3,380 km).
Elevation: *Highest*—Pico Turquino, 6,542 ft (1,994 m). *Lowest*—sea level.
Population: *Estimated 2002 population*—11,268,000; density, 263 per mi^2 (102 per km^2); distribution, 75 percent urban, 25 percent rural. *1981 census*—9,723,605.
Chief products: *Agriculture*—coffee, fruits, sugar cane, tobacco, vegetables. *Manufacturing*—cement, cigars, fertilizers, food processing, leather goods, paper and wood products, refined petroleum, refined sugar, textiles. *Mining*—chromium, cobalt, copper, iron, manganese, nickel.
National anthem: "La Bayamesa" ("The Bayamo Song").
Money: *Basic unit*—peso. One hundred centavos equal one peso. See Peso.

Today, the government of Cuba is highly centralized, and Castro has strong control. The government provides many benefits for the people, including free medical care and free education. But political and economic freedom is severely limited.

Government

According to the Cuban Constitution, which was adopted in 1976, Cuba is a socialist state. It is governed by a single political party—the Partido Comunista de Cuba (Communist Party of Cuba), also known as the PCC. The Constitution established the Communist Party as the leading authority in the government and society. The Central Committee of the PCC is responsible for making the highest levels of policy, and it exercises control over all formal government institutions.

Until the 1990's, membership in the PCC was highly restricted. For example, people who attended religious services were barred from membership. In the 1990's, however, the party began to expand its membership and started allowing churchgoers to join. The PCC also sought to attract greater numbers of young people, women, and Cubans of African descent.

National government. The National Assembly of People's Power is Cuba's chief legislative body. The people elect the 589 deputies of the Assembly to five-year terms. All candidates must have the approval of the Communist Party to appear on the ballot. Citizens who are at least 16 years of age may vote.

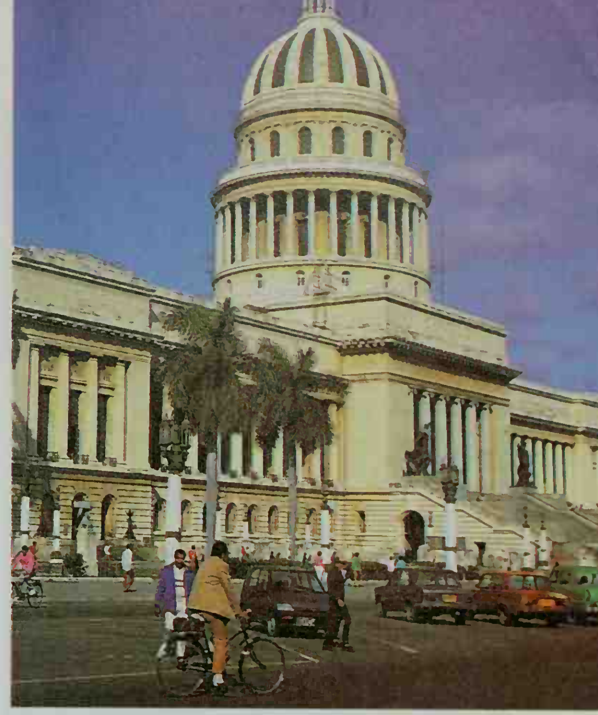
The National Assembly holds two regular sessions a year. Between sessions, the Assembly is represented by the Council of State. The council consists of 31 members elected by the National Assembly from among its deputies. The president of the council is the most powerful official in the Cuban government and serves as both the head of state and head of government.

The president, with the approval of the Assembly, appoints the members of a Council of Ministers. This council enforces laws, directs government agencies, and conducts Cuba's foreign policy.

Provincial and local government. Cuba has 14 provinces, which are divided into about 170 municipalities for purposes of local government. Each province and municipality has an assembly. The people elect the members of each municipal assembly. The municipal assemblies of a province elect the members of the provincial assembly. Cuba's largest offshore island, the Isle of Youth, does not belong to any province and is ruled directly by the central government.

Municipal assemblies supervise and control local economic enterprises, including retail operations and factories that produce goods for the local market. Municipal assemblies also exercise authority over schools, health services, motion-picture theaters and sports facilities, and all transportation within municipal boundaries.

Courts. The People's Supreme Court is Cuba's highest court. It consists of a president, a vice president, and the members of the court's five divisions. These divisions, called *chambers,* are civil and administrative, criminal, labor, military, and state security. Each chamber consists of a president, at least two other professional judges, and a number of *lay judges.* Lay judges are citizens who hold their regular jobs while serving on the Supreme Court.

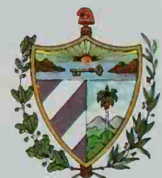


© Bill Lyons, Gamma Liaison

The old Capitol in Havana served as the meeting place of the Cuban legislature from 1929 to 1959. Today the Cuban legislature meets in the Palace of Conventions, and the old Capitol houses the Ministry of Science and a natural history museum.



Cuba's flag was officially adopted in 1902, shortly after Cuba became a republic. The star stands for independence.



Coat of arms. The key means Cuba is the key to the Gulf of Mexico. The stripes are taken from the nation's flag.



WORLD BOOK map

Cuba is an island country between the Caribbean Sea and the Atlantic Ocean, about 90 miles (145 kilometers) south of Florida.

Justices of the Supreme Court are elected by the National Assembly. The president and vice president of the court are nominated by the president of the Council of State and approved by the National Assembly.

Cuba also has a number of lower courts. They include 14 provincial courts and about 170 municipal courts, which operate throughout the island.

Armed forces. Cuba has one of the largest armed forces in Latin America. Approximately 105,000 men and women serve on active duty in the Cuban army, navy, and air force. An additional 135,000 men and women serve in an army reserve. All Cuban men must serve two years of active duty after they reach the age of 16.

People

Ancestry and language. Most Cubans are descendants of people who came to the island from Spain and Africa, but specific information about the ancestry of individual Cubans is often unreliable. According to many authorities, however, about 40 percent of the people are white and of Spanish ancestry, and approximately 10 percent are black. About 50 percent of the people are *mulattoes*—that is, people of mixed white and black ancestry. Cuba also has a small percentage of people of Chinese descent. Spanish is Cuba's official language.

Way of life. The majority of Cuban people live in urban areas. Havana is Cuba's capital, largest city, and commercial and cultural center. Many people in the cities are employed by government agencies or small factories. Some people operate their own small private businesses. Cuba's cities have a severe housing shortage. Many people live in crowded high-rise apartment



Small apartment buildings provide some housing for Cuba's urban dwellers. Many other city people live in high-rise apartments. In many cases, two or more families share an apartment.

buildings. In many cases, two or more families share an apartment. Many buildings are in need of repair. Energy shortages at times result in blackouts, the closing of factories, and a reduction in transportation services.

Most of the people in rural areas work on farms. Many rural people live in *bohíos.* Bohíos are thatch-roofed dwellings with dirt floors.

Before the 1959 revolution, many rural communities lacked health facilities, schools, adequate transportation and communication, and housing. Since 1959, however, the government has built hospitals, clinics, and schools in the countryside. It has also expanded transportation and communication facilities and increased housing construction. Nevertheless, many rural areas of Cuba continue to have housing shortages and to lack certain necessities.

Food and drink. Many Cuban foods are spicy. Rice is the most common Cuban food. It is often served with various kinds of beans, or it is mixed with tomatoes, onions, and green peppers in a dish called *arroz con pollo.* Another popular dish is *picadillo,* which consists of ground beef, pork, or veal mixed with onions, garlic, tomatoes, and other ingredients. Corn meal is used in tamales and many other dishes. Coffee and rum are popular beverages.

Many types of food are scarce in Cuba. As a result, the government has organized a rationing system for the distribution of food. This system is designed to provide all households with minimum quantities of rice, beans, meat, chicken, eggs, sugar, milk, and coffee.

Recreation. Cubans are enthusiastic sports fans. Baseball arrived in Cuba from the United States in the



Health care in Cuba improved under the Castro government. The government built many hospitals, clinics, and dental-care facilities. The hospital shown above is in Havana.

Provinces

Province	Population	Map key	
Camagüey	727,700	C	8
Ciego de Avila	355,500	C	7
Cienfuegos	356,700	B	5
Ciudad de La Habana	2,068,600	A	4
Granma	777,300	D	9
Guantánamo	487,900	E	11
Holguín	927,700	D	10
Isla de la Juventud*	70,900	C	3
La Habana	633,400	A	4
Las Tunas	481,500	D	9
Matanzas	599,500	B	5
Pinar del Río	681,500	B	2
Sancti Spíritus	422,300	C	7
Santiago de Cuba	974,100	E	10
Villa Clara	788,800	B	6

Cities and towns

City	Population	Map key	
Aguada de Pasajeros	12,171	B	5
Artemisa	34,024	B	3
Banes	31,282	D	11
Baracoa	35,538	D	12
Bauta	17,734	A	3
Bayamo†	128,167	D	9
Cabaiguán	25,348	B	7
Caibarién	32,094	B	7
Camagüey†	286,404	C	8
Camajuaní	17,537	B	6
Campechuela	14,151	E	9
Cárdenas	59,501	A	5
Ciego de Avila†	80,500	C	7
Cienfuegos†	125,000	B	6
Colón	35,098	B	5
Consolación del Sur	16,995	B	2
Contramaestre	22,204	D	10
Cruces	18,123	B	6
Cueto	13,552	D	10
Florida	39,700	C	8
Fomento	14,925	B	7
Gibara	14,511	C	10
Guanajay	21,042	A	3
Guantánamo†	203,371	E	11
Güines	41,552	A	4
Güira de Melena	21,145	B	3
Havana (La Habana)	2,119,059	A	3
Holguín†	232,770	D	10
Jagüey Grande	15,540	B	5
Jatibonico	14,863	C	7
Jiguaní	15,042	D	10
Jovellanos	20,899	B	5
La Maya	13,939	E	10
Las Tunas†	120,897	D	9
Los Palacios	13,928	B	3
Manzanillo	87,471	D	9
Matanzas†	115,466	A	5
Mayarí	21,139	D	11
Moa	26,850	D	11
Morón	40,396	B	8
Niquero	15,544	E	8
Nueva Gerona	30,898	C	3
Nuevitas	35,103	C	9
Palma Soriano	55,927	E	10
Palmira	9,856	B	6
Pedro Betancourt	9,033	B	5
Pinar del Río†	124,100	B	2
Placetas	37,535	B	7
Puerto Padre	23,239	C	9
Ranchuelo	14,644	B	6
Remedios	16,176	B	6
Sagua de Tánamo	15,327	D	11
Sagua la Grande	42,741	B	6
San Antonio de los Baños	27,550	A	4
San José de las Lajas	27,279	A	4
San Luis	23,638	E	10
Sancti Spíritus†	75,600	C	7
Santa Clara†	197,189	B	6
Santiago de Cuba†	418,721	E	10
Santo Domingo	12,945	B	6
Trinidad	32,809	C	6
Vertientes	22,440	C	8

*Municipality responsible to central government.
†Provincial capital.
Sources: Official estimates for 1990 and earlier years for provinces and large cities; 1981 census for smaller cities and towns.

late 1800's and quickly became the island's national pastime. Other popular sports include basketball, boxing, swimming, track and field, and volleyball. Soccer also has a national following.

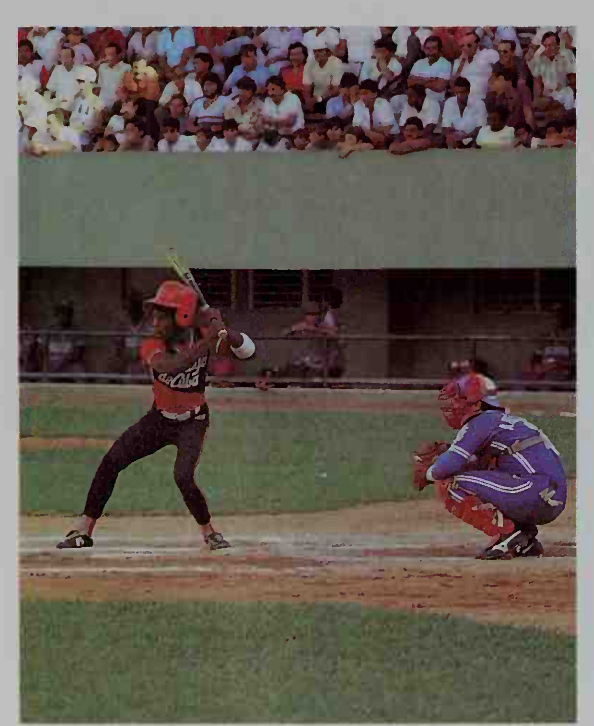
Religion. About 40 percent of the Cuban people are Roman Catholics. Several Protestant groups have widespread membership in Cuba, including Anglicans, Methodists, Baptists, and Presbyterians. A small Jewish community is concentrated mostly in Havana.

Some Cubans believe in Santería, a religion that combines certain traditional African religious beliefs and some Roman Catholic ceremonies. Followers of Santería believe that the Catholic saints correspond to African spirits called *orishas.*

Education. Cuba has one of the most extensive networks of schools in Latin America, from preschool facilities to graduate and professional programs. All Cubans from the ages of 6 to 14 are required to attend school. Education is free. Centers of higher education include the University of Havana, the Central University of Las Villas in Santa Clara, and the University of Oriente in Santiago de Cuba. Nearly all adult Cubans can read and write. For the country's literacy rate, see **Literacy** (table).

The arts. Cuba has a distinguished tradition in the arts. The Cuban government strongly supports the arts and sponsors free ballets, plays, and other cultural events for Cubans. The work of the government-sponsored Institute of Cinema Art and Industry has made Cuba a center of the Latin American film industry.

Cuban paintings are known primarily for their strong colors and portrayals of dramatic actions. Armando Menocal, who began painting in the late 1800's, became famous for his murals and depictions of historical events. Well-known Cuban painters of the 1900's include Amelia Peláez and Wifredo Lam. Peláez pioneered the introduction of modern art in Cuba. Lam combined both African and Cuban elements in his works.



© Mel Rosenthal, The Image Works

Baseball is highly popular in Cuba and is played in parks and stadiums and on playgrounds throughout the island. The game arrived in Cuba from the United States in the late 1800's.

José Martí was the most famous Cuban writer of the 1800's. Martí, who helped lead Cuba's fight for independence from Spain, wrote eloquently on political subjects. He also was a poet. The most prominent Cuban novelists of the early and middle 1900's included Carlos Loveira, Alejo Carpentier, and José Lezama Lima. Loveira wrote about social and political injustice. Carpentier produced works in the style of *magic realism.* Magic realism blends dreams and magic with everyday reality. Lezama published poetry and literary reviews. Guillermo Cabrera Infante became one of Cuba's outstanding novelists and short-story writers of the late 1900's. His innovative works of fiction are filled with puns and other kinds of wordplay.

Cuban popular music has gained worldwide renown. This highly rhythmic music combines African and European, especially Spanish, traditions. Much Cuban music features guitars and such percussion instruments as castanets, maracas, and a variety of drums, including bongo drums. Cuban music has given rise to a number of dances, including the *cha-cha-cha, conga, mambo, rumba, son,* and *Cuban bolero.*

The land

Cuba lies about 90 miles (145 kilometers) south of Key West, Florida. It consists of a main island (Cuba) surrounded by more than 1,600 smaller islands. The Cuban mainland extends about 710 miles (1,150 kilometers) from northwest to southeast. The mainland and its surrounding islands cover 42,804 square miles (110,861 square kilometers). At its widest point, the island measures 135 miles (217 kilometers). At its narrowest point, it reaches only about 20 miles (32 kilometers).

Cuba consists mainly of three mountainous regions separated by gentle slopes, rolling plains, and wide, fertile farmlands. The three mountainous regions rise in the west, in south-central Cuba, and in the southeast.

The westernmost mountainous region of Cuba consists of two mountain ranges—the Sierra de los Órganos and the Sierra del Rosario. The south-central mountainous region is known as the Sierra de Escambray. It includes the Sierra de Trinidad and the Sierra de Sancti Spíritus ranges. The southeastern mountainous zone has several ranges. Among them is the Sierra Maestra range, which rises abruptly from the southeastern coast. The highest point in Cuba, the Pico Turquino, stands 6,542 feet (1,994 meters) high in the Sierra Maestra.

Cuba has more than 200 rivers and streams. Most of them are short, narrow, and shallow. Few inland waterways on the island can be navigated for any great distances. The longest river, the Cauto, flows about 150 miles (240 kilometers) through southeastern Cuba. It is navigable for only about 40 miles (65 kilometers).

The coastline of Cuba measures approximately 2,100 miles (3,380 kilometers) long. It is marked with deep bays and sandy beaches. Much of the southern shoreline of Cuba in the west consists of a band of low marshland that is broken up into hundreds of *coral keys* and *mangrove swamps.* Coral keys are low islands that

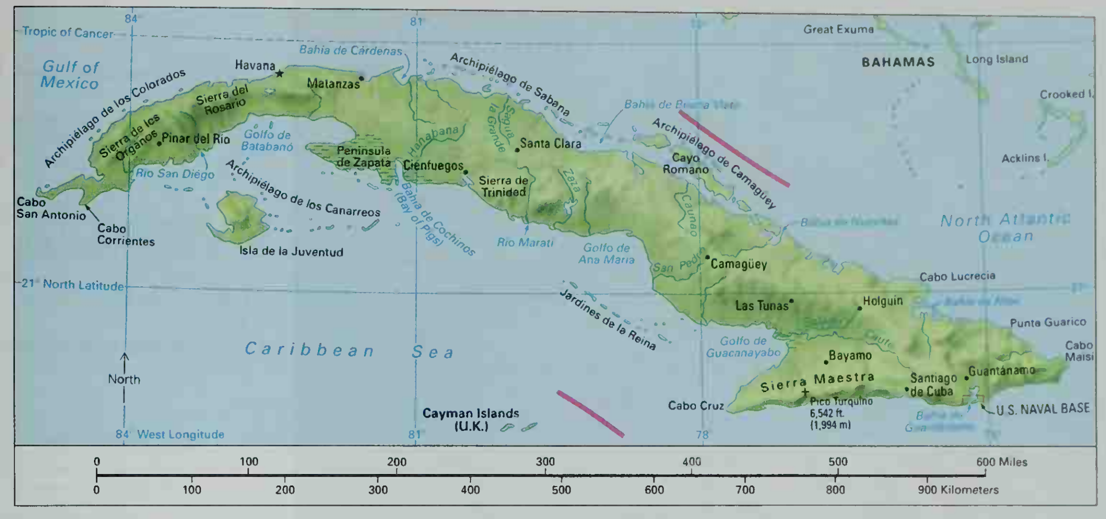
Cuba physical map

Numerous coral reefs and small islands form bays along the Cuban coast. Cuba also has many small rivers. Pico Turquino, the country's highest mountain, rises in the Sierra Maestra range.

Geographical Terms
Archipiélago............islands
Bahía............bay
Cabo............cape
Golfo............gulf
Pico............mountain
Río............river
Sierra............mountain range

★ National capital
• Other city or town
+ Elevation above sea level
Swamp

WORLD BOOK map



form when coral growths build up above the water. Mangrove swamps are created when the spreading roots of mangrove trees catch and hold soil. West of Cienfuegos lies the Zapata Peninsula, a vast swampland.

Cuba has over 200 natural harbors along its shoreline. The larger harbors have narrow entrances, which protect the inner area against winds and waves. Important northern harbors include Antilla, Cabañas, Cárdenas, Gibara, Havana, Honda, Manatí, Mariel, Matanzas, Nuevitas, and Puerto Padre. The chief southern harbors include Cienfuegos, Guantánamo, and Santiago de Cuba.

Climate

Cuba lies within the northern tropics and has a semitropical climate. Cool ocean breezes during the summer and warm breezes in the winter give the island a mild climate throughout the year. Average daily temperatures in Cuba range from about 70 °F (21 °C) in winter to about 80 °F (27 °C) in summer. The interior has a greater temperature range than the coastal regions. Temperatures on the island rarely fall below 40 °F (4 °C) or rise above 100 °F (38 °C). Frosts sometimes occur in the mountains.

Cuba has a dry season and a rainy season. The dry season lasts from November through April, and the rainy season runs from May through October. Cuba has an average annual rainfall of more than 50 inches (125 centimeters). Thunderstorms occur almost daily in the rainy season.

Hurricanes frequently strike the island. Hurricane season lasts from June to November. The strong winds from hurricanes occasionally destroy buildings and crops and create high waves that flood the coastal lowlands. Earthquakes also occasionally hit Cuba. They occur most frequently and most severely along the southeastern coast.

Economy

Cuba has a *gross domestic product* (GDP) of about $15 billion. A country's GDP is the total value of all goods and services the country produces in a year. Cubans have a *per capita* (per person) income of about $1,300.

From 1961 to the early 1990's, government planning dominated the key economic decisions of the country. During that time, the Cuban economy declined. The country relied heavily on aid from, and trade with, the Soviet Union and the nations of the Communist bloc of Eastern Europe.



© Marc Pokempner

Workers harvest sugar cane on a government-operated farm. Sugar cane has long been Cuba's most important crop by far, and Cuba ranks as one of the world's leading producers of sugar.



World-famous Cuban cigars rank among the island's leading exports. The best cigars are made from tobacco grown in the Vuelta Abajo region in northwestern Cuba. Skilled workers, *left,* roll the cigars by hand, the traditional method of making high-quality cigars.

Communism collapsed in Eastern Europe during the late 1980's, and the Soviet Union broke apart in 1991. These political changes resulted in a loss of economic aid for Cuba. To combat the severe economic crisis brought on by this loss of aid, the Cuban government somewhat loosened its control over the economy. Foreign investment, which had previously been discouraged by the government, began to return to the island, principally in tourism. In 1993, some private enterprise was gradually permitted. Many Cubans began to open small businesses, including restaurants and clothing stores.

Manufacturing centers on sugar production. Cuba has more than 100 sugar mills throughout the country. The manufacture of cigars is also important. Cuba is famous for fine hand-rolled cigars made from high-quality tobacco. Most cigar factories are in Havana. Other important industrial activities in Cuba include oil refining and the production of fertilizer, food products, cement products, textiles, paper and wood products, and leather goods.

Agriculture. Sugar cane has long been Cuba's most important crop by far, and Cuba is one of the world's leading producers of sugar. Sugar cane is grown throughout the island. Tobacco and coffee are also important crops.

Through the years, the government has promoted attempts to grow other crops as a way for the country to supply more of its own food. As part of these efforts, the government has tried to increase the production of bananas, citrus fruits, corn, rice, potatoes, and tomatoes. The government has also attempted to increase the production of livestock farming, particularly the raising of beef and dairy cattle, hogs, and chickens.

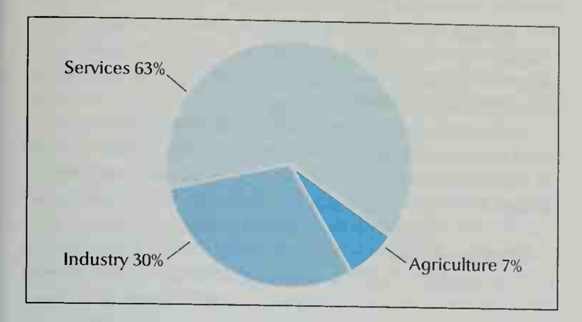
During the 1960's, nearly all farmland came under state control. Most farms were run as *state farms,* owned and operated by the government. Some farms were reorganized and operated as *farm cooperatives,* which were owned jointly by the government and groups of farmers. Some small farms remained under the control of individual owners. In all cases, farmers were required to sell their products to the state at prices set by the government. In 1994, however, the government authorized farmers to sell their surplus production on the open market after certain quotas had been met. Soon, small farmers' markets sprang up across the island and sold directly to the public a variety of products, including fruits, vegetables, and other foods.

Mining. Cuba's mines produce chromium, cobalt, copper, iron ore, manganese, and nickel. Most of the country's nickel mines are on the eastern end of the island. Cuba also produces small quantities of petroleum, mostly for its own use.

Fishing industry. State-owned Cuban fishing fleets range over the Caribbean Sea and parts of the North Atlantic Ocean. The chief fish caught include tuna and such shellfish as lobsters and shrimp. Caibarién, Cienfuegos, and Havana are among the important fishing ports.

Service industries are those industries that produce services rather than manufactured goods or agricultural products. They include banking, education, and health care. One of the fastest-growing service industries in

Cuba's gross domestic product



The gross domestic product (GDP) is the total value of goods and services produced within a country in a year. The GDP measures a nation's total economic performance and can be used to compare the economic output and growth of different countries. Cuba's GDP was $14,700,000,000 in 1995.

Production and workers by economic activities

Economic activities	Percent of GDP produced	Employed workers: Number of persons	Employed workers: Percent of total
Community, social, & personal services*	34	1,413,000	30
Manufacturing, mining, & utilities	21	1,036,000	22
Wholesale & retail trade	19	518,000	11
Transportation & communication	10	330,000	7
Construction	9	471,000	10
Agriculture	7	942,000	20
Total	100	4,710,000	100

*Includes government and financial services.
Figures are for 1995.
Source: *World Book* estimates based on data from the U.S. Central Intelligence Agency.

Cuba is tourism. Largely as a result of foreign investment, new hotels and motels have been constructed, and old ones have been restored. Tourists are arriving in growing numbers, mainly from Canada, Europe, and Latin America.

International trade. From about 1900 to 1960, Cuba's principal trading partner was the United States. During the 1950's, about 65 percent of Cuban exports and about 75 percent of all imports were related to Cuban-U.S. trade. Beginning in the early 1960's, Cuban trade shifted largely to the Soviet Union and the Communist countries of Eastern Europe. By the mid-1980's, about 85 percent of all Cuban trade was with the Communist bloc. The collapse of Communism left Cuba in search of new trading partners. After 1991, Cuba's chief trading partners became Canada, China, Italy, Japan, Mexico, Russia, Spain, Ukraine, and Venezuela.

Through the years, sugar has remained Cuba's principal export product. Other exports include citrus fruits, coffee, fish and shellfish, medical products, nickel, rum, and tobacco products. Among Cuba's chief imports are chemical products, food, machinery, and petroleum.

Transportation and communication. More than 18,000 miles (29,000 kilometers) of roads crisscross the island. The Central Highway extends between Pinar del Río and Santiago de Cuba. However, gasoline rationing, problems in obtaining spare parts, and a scarcity of new vehicles make automobile transportation difficult. In the cities, many people travel by bicycle. Railroads cross the island, but more people ride buses—when the buses have enough fuel to operate—than trains. José Martí International Airport is the country's largest airport.

More than 15 newspapers are published on the island. The principal newspaper is *Granma,* published by the Cuban Communist Party. The government controls all newspapers, magazines, and television and radio broadcasts. Advances in telecommunications, however, including satellite broadcasts, have enabled Cubans to receive TV and radio broadcasts from the United States. In addition, Radio Martí, which is operated by the United States government, provides daily news broadcasts to the island.

History

Early years. The famous explorer Christopher Columbus landed in Cuba in 1492. At the time of Columbus's arrival, three groups of Indians inhabited the island: the Guanahatabey, the Ciboney, and the Taíno. Estimates of the size of the Indian population at the time of European arrival vary widely—from as few as 16,000 to as many as 600,000.

Spanish soldiers and priests arrived in Cuba in 1511. The Indians resisted the Spanish effort to take over the island but were soon defeated. The Spaniards then forced the Indians to work in agriculture and mining. Many Indians died from diseases and harsh treatment. By the mid-1500's, only a few thousand Indians remained. As the Indian population declined, the Spaniards began to import African slaves. The first African slaves arrived in Cuba in the 1520's.

The island became strategically important to the Spanish colonial system in the New World. Control of Cuba offered Spain command of sea routes to Mexico, the Gulf Coast, western Florida, and Central America, as well as the chief sea lanes of the Caribbean. In 1564, Spain officially introduced its *fleet system.* Under this system, its merchant vessels, carrying treasure from the New World, sailed together in groups called *convoys,* which were protected by warships. Havana became the gathering place for the treasure ships before they set sail in convoys for Spain. Havana soon emerged as the political, administrative, economic, and cultural hub of the country.

In 1762, the British seized Havana during the Seven Years' War, known in the United States as the French and Indian War. During their occupation, the British introduced reforms and established new trade ties between Cuba and the British colonies of North America.

The British returned control of Havana to Spain in 1763. In the years after the restoration of Spanish rule, Spain eased trade restrictions, abolished all duties on Cuban imports, and opened Cuban ports to unlimited free trade in slaves. These actions helped the Cuban economy flourish.

In the late 1700's, a rebellion of black slaves in the French colony of Saint Domingue (now Haiti) destroyed the production of sugar and coffee on that island. About the same time, the world price of these products soared. In response to this situation, Cuban producers

soon launched coffee production in eastern Cuba and expanded sugar cane cultivation throughout the island, beginning in the west.

Through the years, sugar emerged as the most important Cuban export. Expanding sugar production led to the desire for more cheap labor. As a result, tens of thousands of African slaves were brought onto the island. Many owners treated their slaves brutally. In 1812, a group of slaves, headed by José Antonio Aponte, planned a revolt. The Spaniards discovered the plot and hanged Aponte and his followers.

Struggle against Spain. By the mid-1820's, nearly all of Spain's colonies in Latin America had won their independence. During the 1800's, various Cuban groups sought to end Spanish rule of their country as well.

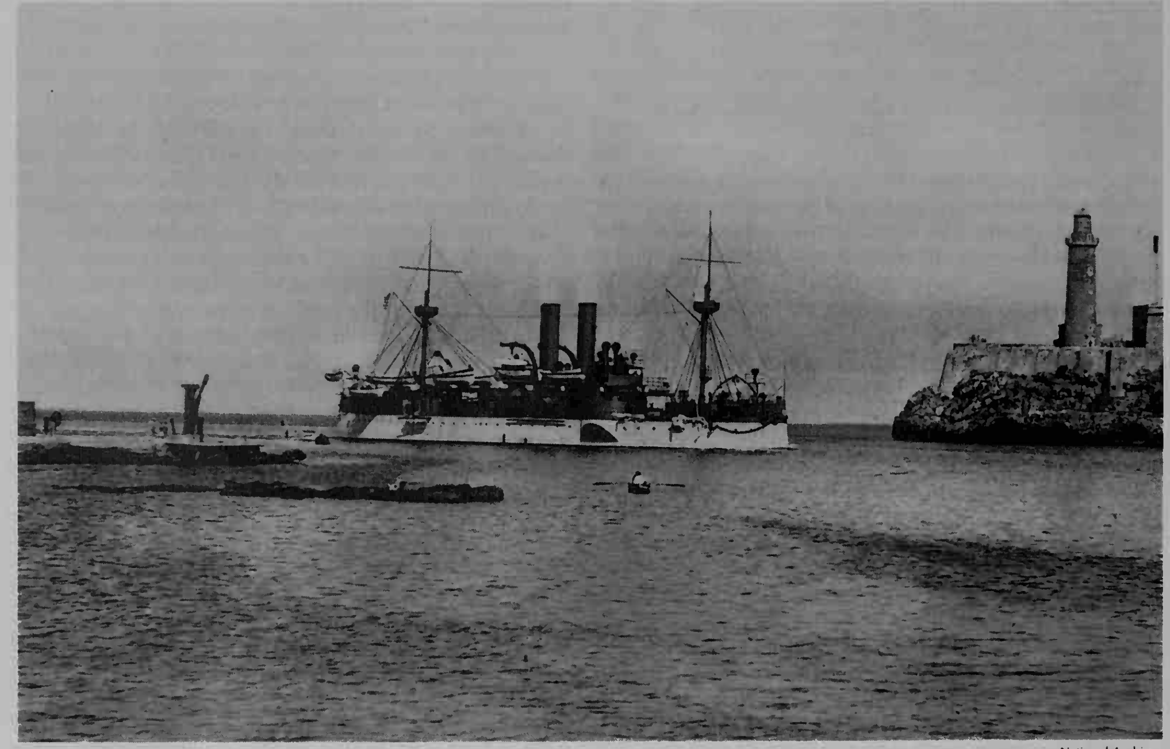
During the mid-1800's, some Cubans and Americans supported a movement to *annex* (join) Cuba to the United States. The annexation movement received much support from Cuban and American slaveholders. These people feared that ongoing unrest among the slaves on the island would lead Spain to end slavery in Cuba. Other groups in Cuba and the United States favored American control of the island for economic and military reasons. The United States made several offers to buy Cuba, but Spain rejected them.

Cuba's struggle against Spanish rule led to the outbreak of the Ten Years' War in 1868. Carlos Manuel de Céspedes, a landowner, headed a revolutionary group largely made up of poor whites, mulattoes, free blacks, and slaves. The group demanded independence from Spain, the establishment of a republic, and the emancipation of the slaves. Spain rejected the group's demands, and bitter fighting followed. The war ended with the signing of the Pact of Zanjón in 1878. This treaty provided for political reforms and for the liberation of slaves who had joined the rebel army. Slavery was abolished in Cuba in 1886.

By the early 1890's, Cubans were again preparing to fight for independence. Largely as a result of the efforts of the writer José Martí, the separatists organized the Cuban Revolutionary Party. In 1895, they launched a new war for the independence of the island.

President William McKinley of the United States claimed that the fighting on the island threatened American interests. He told the Spanish government to either change its policy toward Cuba or give up the island completely. In February 1898, the U.S. battleship *Maine,* which had been sent to Havana to protect Americans in Cuba, exploded mysteriously. The United States blamed Spain for the explosion and, in April, declared war on Spain. This war became known in the United States as the Spanish-American War. In Cuba, the war that was fought from 1895 to 1898 is called the Spanish-Cuban-American War.

The U.S. intervention delivered the final blow to the Spanish army in Cuba. The Spanish army in Cuba surrendered in July 1898, and an armistice in August ended the fighting. Under the Treaty of Paris, which was signed on December 10, Spain gave up all rights to the island. The United States then set up a military government in Cuba. Consequently, the Cubans did not achieve the independence they had hoped to gain. Instead, Cuba



National Archives

The U.S. battleship *Maine* arrived in Havana in 1898 to protect Americans during Cuba's fight for freedom from Spain. The ship exploded mysteriously, triggering the Spanish-American War.

was occupied by another foreign country—the United States.

The Platt Amendment. In 1901, Cuba adopted a constitution. The United States insisted that the Constitution include a set of provisions called the Platt Amendment. The amendment limited Cuban independence by permitting the United States to intervene in Cuban affairs. It also limited the Cuban government's power to make treaties with other governments. The amendment required Cuba to allow the United States to buy or lease land for naval bases on the island. Under a treaty with Cuba in 1903, the United States received a permanent lease on Guantánamo Bay and began to build a large naval base there.

The government of Cuba from 1902 to 1934, except for the years 1906 to 1909, is sometimes called the Platt Amendment Republic or the Plattist Republic. The period of the Plattist Republic was marked by political instability, public corruption, and popular protest. During this period, the United States gained increasing control over the economic affairs of Cuba. The United States began to dominate Cuban trade.

In 1901, the Cuban people elected Tomás Estrada Palma as the first president of the Republic of Cuba. American troops left the country. In 1906, violent protests broke out in Cuba over the disputed outcome of a presidential election. United States troops then returned to Cuba. A government headed by Charles E. Magoon of the United States ruled Cuba from 1906 to 1909. The United States returned control of the country to the Cubans in 1909. American forces left the country, but the United States retained naval bases on the island.

A black uprising broke out in Cuba in 1912. The protesters objected to the lack of political opportunity for blacks in Cuba. In 1917, a revolt protesting electoral fraud broke out. During both uprisings, the United States sent military forces into the country.

The Cuban people elected Gerardo Machado president in 1924. During his campaign, Machado had attacked the Platt Amendment and had promised reforms. But after becoming president, he ruled as a dictator. In August 1933, a general strike and an army revolt forced Machado out of office. A month later, an army sergeant named Fulgencio Batista y Zaldívar and a group of university students and professors led a military revolt that overthrew the new government. They named a five-man government, headed by a former university professor named Ramón Grau San Martín, to rule Cuba.

The Grau government wanted to reduce U.S. influence in Cuba and make far-reaching changes. The government passed a number of measures, including laws that established an eight-hour workday and required all Cuban businesses to employ Cubans for at least half of their total work force. The United States and many Cubans refused to recognize the Grau government.

The Batista era. Batista forced Grau to resign from office in 1934. Until 1940, Batista ruled Cuba as dictator through presidents who served in name only. The Unit-

Important dates in Cuba

1492 Christopher Columbus landed in Cuba.

1520's The first African slaves arrived in Cuba.

1762 The British seized Havana. They returned it to Spanish control in 1763.

1868-1878 Cuban revolutionaries fought Spanish rule in the Ten Years' War. Under the Pact of Zanjón, which ended the war, Spain promised reforms.

1886 Slavery was abolished in Cuba.

1895 A revolution, led by José Martí, broke out in Cuba against Spanish rule.

1898 The United States, supporting the Cuban rebels, defeated Spain in the Spanish-American War. Spain gave up all claims to Cuba.

1899-1902 A U.S. military government controlled Cuba.

1901 Cuba adopted a constitution that included a set of provisions called the Platt Amendment. The amendment allowed the United States to intervene in Cuban affairs.

1902 Tomás Estrada Palma became the first president of the Republic of Cuba.

1906-1909 United States forces again occupied Cuba.

1933 A revolutionary group led by Fulgencio Batista y Zaldívar took control of the government.

1934 The United States and Cuba signed a treaty that canceled the Platt Amendment.

1959 Fidel Castro's forces overthrew Batista's government, and Castro became ruler of the country.

1961 Cuban exiles sponsored by the U.S. Central Intelligence Agency (CIA) invaded Cuba at the Bay of Pigs and were quickly defeated by Castro's army.

1962 The Soviet Union agreed to U.S. demands that it remove its missiles from Cuba and dismantle the remaining missile bases on the island.

1976 Cuba adopted a new constitution that established the Communist Party as the leading authority in the government and society.

1991 The Soviet Union, which had been an important source of economic aid to Cuba, was dissolved. Cuba's economy suffered greatly as a result.

1993 Cuba instituted economic reforms that allowed some workers to start private businesses.



United Press International

Fulgencio Batista, famous for his fiery speechmaking, ruled Cuba as dictator from 1934 to 1940, as an elected president from 1940 to 1944, and again as dictator from 1952 to 1959.

ed States recognized and supported Batista's government. In 1934, the United States and Cuba signed a treaty that canceled the Platt Amendment, except for the Guantánamo Bay lease. United States investments in Cuba continued to expand during the 1940's and 1950's. For example, American interests eventually controlled more than 90 percent of Cuba's telephone and electrical services and about 40 percent of its sugar production. The United States also continued to be Cuba's most important trading partner.

In 1940, Cubans adopted a new constitution and elected Batista president. The Constitution prevented Batista from seeking reelection in 1944, and Grau became president again. Carlos Prío Socarrás won the 1948 election.

In 1952, Batista overthrew Prío's government and became dictator again. Batista stressed the development of light industry and encouraged foreign companies to build businesses in Cuba. He also improved public works. But many Cubans remained unemployed and in poverty, and political conflict expanded across the island. Strikes and demonstrations became common.

The Castro revolution. On July 26, 1953, Fidel Castro, a young lawyer, tried to start a revolution against Batista by attacking the Moncada army barracks in Santiago de Cuba. Castro was captured and imprisoned. Many of his followers were either imprisoned or murdered. Castro was released from prison in 1955 and went to Mexico. In 1956, he organized the 26th of July Movement, which was named after the date of his first revolt. Castro's forces landed in Oriente Province in December 1956. Most of the rebels were imprisoned or killed. However, Castro and about a dozen of his followers escaped to the Sierra Maestra.

In 1957, Castro's forces began to wage a guerrilla war against the Cuban government. The same year, university students stormed the presidential palace in an attempt to assassinate Batista. Attempts by the government to crush the revolution increased the people's support of the rebels. Continued poor economic conditions also led to growing support for the rebels, particularly among workers, peasants, students, and the middle class. By mid-1958, Batista's government had lost the support and confidence of both the United States and the Cubans.

On Jan. 1, 1959, Batista fled the country. Castro's forces then took control of the government. Later, Castro became prime minister of Cuba. The revolutionary leaders did away with the political and military structure of Batista's government. Many former political officials and military officers were tried and executed. A large number of middle- and upper-class Cubans went into exile in Florida.



UPI/Corbis-Bettmann

Fidel Castro, a young revolutionary, became the head of the Cuban government in 1959 after he and his supporters waged a guerrilla war and overthrew the dictatorship of Fulgencio Batista.

The new Cuban government immediately set out to change Cuban relations with the United States. In particular, it sought to reduce U.S. influence on Cuban national affairs. In 1960, for example, the Cuban government seized U.S.-owned businesses, including sugar estates. As a result, relations between Cuba and the United States quickly became strained.

As relations with the United States declined, Cuba developed stronger ties with the Soviet Union and became a Communist country. In early 1960, Castro's government signed a broad economic pact with the Soviet Union.

In June 1960, the Castro government took over American and British oil refineries in Cuba after the refineries refused to process crude oil imported from the Soviet Union. The United States then stopped buying sugar from Cuba. Over the next few months, the Castro government took over all the remaining American businesses in Cuba and accepted Soviet military assistance. In October, the United States placed an economic embargo on Cuba, which banned all U.S. exports except medicines and some food products. In January 1961, the United States ended diplomatic relations with Cuba.

The Bay of Pigs invasion. In April 1961, Cuban exiles sponsored by the United States Central Intelligence Agency (CIA) invaded Cuba at the Bay of Pigs on the south coast. Castro's forces crushed the invasion and captured most of the exiles. Castro later released many of the exiles to the United States in exchange for nonmilitary supplies.

The Cuban missile crisis. Cuban leaders feared another direct U.S. invasion. The Soviet Union offered military aid to Cuba, and Cuba agreed to let the Soviet Union send missiles and materials to build launch sites. In October 1962, the United States learned that Cuba had nuclear missiles in place that could be launched toward American cities. President John F. Kennedy ordered a naval blockade to halt the further shipment of arms. He demanded that the Soviet Union remove all missiles from the island and dismantle the remaining missile bases. For several days, the world stood on the brink of nuclear war. Finally, the Soviet Union removed the weapons under protest from Castro. The Soviet action came after Kennedy privately agreed not to invade Cuba. Kennedy also agreed to remove U.S. nuclear missiles from Turkey, which the Soviets considered to be a threat.

Social programs. The Castro government built many new schools and improved old ones, and school enrollments and literacy rates increased dramatically. The government also improved medical and dental care facilities across the country and built new ones. The number of doctors and other health professionals increased. Health conditions improved, and life expectancy increased. Social reforms also led to more opportunities for minorities. Women began attending universities in greater numbers. Larger numbers of women joined the

labor force. Blacks also received increased educational, employment, and political opportunities.

On the other hand, many opponents of the government were jailed, and Cuba came under sharp criticism from international human rights groups. In addition, the Cuban people were denied many political and economic freedoms. The Cuban economy declined under Castro, and the people suffered from shortages of food and housing.

Foreign relations. From the 1960's to the 1980's, Castro tried to spread revolution throughout Latin America, mainly by supplying military aid to guerrilla groups in a number of Latin American countries. Cuba also sent troops and civilian military advisers to aid certain groups in Angola and several other African countries. The Soviet Union provided most of the military supplies for Cuba's African operations.

Relations between Cuba and the United States remained strained, despite occasional signs of improvement. The United States kept its embargo, first imposed in 1960, in place.

During the 1990's, the United States passed legislation, including the Helms-Burton Act of 1996, to broaden trade sanctions against Cuba. In 2000, however, Congress passed legislation allowing sales of U.S. food and medicine to Cuba.

Another serious issue between Cuba and the United States involved the immigration of Cubans to the United States. After the revolution, hundreds of thousands of Cubans left the country because of their opposition to Castro or because of dissatisfaction with their social and economic conditions. Most of these people settled in the United States, which had a policy of providing political asylum to all Cubans who reached its shores. Other Cuban exiles settled in such Spanish-speaking countries as Mexico and Spain.

An especially large immigration wave took place between April and September of 1980, when more than 125,000 Cubans moved to the United States. This event became known as the Mariel boat lift because the refugees left from the Cuban port of Mariel. After another large immigration in 1994, Cuba and the United States reached an immigration agreement. The United States said it would admit at least 20,000 new immigrants from Cuba annually. In return, Cuba pledged to do more to prevent illegal departures.

Recent developments. In the late 1980's, the Soviet Union and other European Communist countries began programs to give their people more political and economic freedom. Castro criticized these reform efforts. Non-Communist governments replaced Communist governments in most of the Eastern European countries during the late 1980's.

In December 1991, the Soviet Union was dissolved, its Communist government was replaced, and Cuba lost its most important source of aid. Cuba's economy suffered severely as a result.

Cuba soon took a number of steps aimed at easing its economic crisis. For example, it undertook limited reforms that loosened state control over parts of the country's economy. It also sought to improve relations with other countries, particularly Canada and European and Latin American nations, in an attempt to stimulate foreign investment in Cuba. Louis A. Pérez, Jr.

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Outline

Questions

Why did Cuba suffer a severe economic crisis in the early 1990's? What are some of the steps the government took to ease the crisis?
What is Cuba's most important crop?
What was the Platt Amendment?
What are some Cuban dances?
What was the 26th of July Movement?
Why does Cuba have a mild climate the year around?
In what ways was Cuba important to Spain's empire in the New World?
What official is the most powerful person in the Cuban government?
What was the Cuban missile crisis?
What is Cuba's national pastime?
How have the Cuban people benefited from the Castro government? In what ways have the people of Cuba been limited by the government?

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Cuban missile crisis occurred in October 1962 when the United States learned that the Soviet Union had secretly installed missiles in Cuba, about 90 miles (140 kilometers) from Florida. The missiles could have been used to launch nuclear attacks on American cities. The crisis was one of the most serious incidents of the Cold War, a period of intense U.S.-Soviet rivalry that had begun after World War II ended in 1945. Most experts

believe that the missile crisis brought the United States and the Soviet Union to the brink of nuclear war.

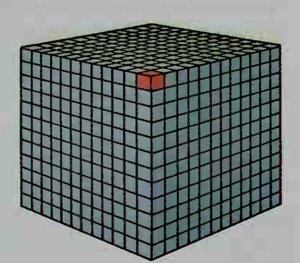
The Soviet Union had placed the missiles in Cuba earlier in 1962, after Cuban leaders became convinced that the United States was planning to attack Cuba. During the Cold War, Cuba was an ally of the Soviet Union. President John F. Kennedy of the United States learned of the missiles' presence on October 16 and demanded that the Soviet Union remove them. On October 22, he ordered a naval *quarantine* (blockade) of Cuba to stop further shipment of arms.

At first, the United States expected to invade Cuba to destroy the missiles. At one point, an invasion was scheduled for October 29 or October 30. Nearly all of Kennedy's advisers agreed that a landing of U.S. forces in Cuba would probably mean war—most likely nuclear war—with the Soviet Union.

The Soviet Union offered to remove the missiles if the United States would promise not to invade Cuba. It later said that it would not remove the missiles unless the United States would dismantle its military bases in Turkey. Turkey was a U.S. ally that bordered the Soviet Union. Kennedy agreed publicly to the first Soviet proposal. But Kennedy also sought a private agreement to quietly remove all U.S. nuclear missiles from Turkey in exchange for the removal of the Soviet missiles from Cuba. On October 28, Soviet leader Nikita S. Khrushchev accepted Kennedy's offer, ending the crisis.

The agreement between Kennedy and Khrushchev was kept secret because many Americans opposed such a deal. Almost all Americans thus thought that Kennedy had forced the Soviet Union to remove the missiles simply by threatening war. Some experts believe that, as a result, U.S. foreign policy used greater toughness and more threats of force after the crisis. James Nathan

Cube, in geometry, is a solid bounded by six square faces of equal size. A cube has 12 edges, all of which are equal to one another. The *volume* of a cube, or the space it fills, is expressed in cubic inches, cubic feet, cubic centimeters, or some other cubic unit. The volume is found by multiplying the number that represents the length of one of the edges by itself, then multiplying by the length again. For example, if the edge of a cube is 4 meters long, the volume of the cube is $4 \times 4 \times 4$, or 64, cubic meters. In arithmetic, the *cube* of a number is the product obtained when a number is used as a factor three times. Thus, the cube of 4 is $4 \times 4 \times 4$, or 64. This can be indicated by 4^3.



WORLD BOOK illustration by Sarah Woodward

A cube is bounded by six square faces. Each face of a cube of one cubic foot is 12 inches long and 12 inches wide. The volume is $12 \times 12 \times 12$, or 1,728, cubic inches. The small red cube is $\frac{1}{12}$ of the length, width, and height.

See also **Archimedean solid** (picture); **Cube root; Root.**

Mary Kay Corbitt

Cube root is one of three equal factors of a number (see **Factor**). The same number (m) taken as a factor three times is the cube root of another number (n). Thus, $m \times m \times m = n$. For example, 2 is the cube root of 8, because $2 \times 2 \times 2 = 8$, and -5 is the cube root of -125, because $-5 \times -5 \times -5 = -125$. A real number has only one real cube root, which is positive or negative, according to whether the given number is positive or negative. When a cube root or any other root of a number is to be *extracted* (determined), another symbol is placed over the number. This symbol is written $\sqrt{\ }$, and is called the *root sign,* or *radical sign.* If the root to be extracted is a cube root, a small figure 3 is added to the root sign. Thus, $\sqrt[3]{8}$ indicates that the cube root of 8 is to be determined.

To find the cube root of a number, you can use a scientific calculator, or you can look up the root in a table of cube roots. If neither of these is available, you must calculate the root.

You can use a procedure called *Newton's method* to calculate the cube root of a number between 1 and 1,000. For example, you might wish to find the cube root of 200. Since $5 \times 5 \times 5 = 125$, and $6 \times 6 \times 6 = 216$, it is easy to see that 6 is the closest *integral,* or whole number, cube root of 200. A closer complete approximation can be made by dividing 200 by the square of 6, or 6×6, which equals 36. To the nearest tenth, this gives 5.6. Thus, $6 \times 6 \times 5.6$ is approximately 200.

To get the second approximation of the cube root of 200, average the three factors 6, 6, and 5.6. This will give $\frac{6+6+5.6}{3} = 5.9$. This procedure is repeated to obtain a still better approximation. Thus, $\frac{200}{5.9 \times 5.9} = \frac{200}{34.81} = 5.74$, and the next approximation is given by $\frac{5.9+5.9+5.74}{3} = 5.85$. Repeating once more gives $\frac{200}{5.85 \times 5.85} = \frac{200}{34.2225} = 5.8441$, which gives the next approximation $\frac{5.85+5.85+5.8441}{3} = 5.8480$.

This process may be continued indefinitely. In each approximation beyond the second, you can retain a number of digits that is one less than twice the number of digits found in the previous approximation. For example, the second approximation, 5.9, contains two digits. The third approximation may retain three digits, and the fourth approximation may retain five digits.

If the number whose cube is desired is not between 1 and 1,000, either multiply or divide it successively by 1,000 to bring it within this range. The cube root of this number will lie between 1 and 10. After finding the cube root, either divide or multiply it successively by 10 as many times as necessary to give the cube root of the original number. Robert M. Vancko

See also **Cube; Root.**

Cubeb, *KYOO behb,* is the dried, unripe berry of a climbing vine belonging to the pepper family. It grows in Pinang, Sumatra, New Guinea, and neighboring islands. It resembles black pepper. Cubebs are used as spices in Asia, and as medicine in Europe and America. Drugs prepared from cubebs are used as kidney stimulants, urinary antiseptics, and expectorants. Cubebs, in the form of cigarettes, were formerly used to treat hay fever, asthma, and pharyngitis.

Scientific classification. The cubeb belongs to the family Piperaceae. Its scientific name is *Piper cubeba.*

W. Dennis Clark

Cubic measure. See Weights and measures.

Cubism was the most influential movement in the history of modern art. The Cubists introduced radically new approaches to rendering form and space.

Cubism began in France, where it flourished as a movement between 1907 and 1914. The leaders of the movement were the Spanish-born artist Pablo Picasso and the French artist Georges Braque. Other Cubists included Juan Gris of Spain and Robert Delaunay and Fernand Leger of France. The aims of the movement were first expressed in a 1912 book by two other French Cubist painters, Albert Gleizes and Jean Metzinger.

The Cubist painters shunned conventional treatment of space and form. A typical Cubist painting analyzes the subject in basic geometric shapes and elementary signs. By reorganizing these elements and freeing them from direct reference to objects seen in nature, the Cubists developed a new language of representation.

Many Cubist paintings and sculptures are still lifes that represent such commonplace objects as tabletops, musical instruments, bottles, and glassware. Cubist painters and sculptors were often inspired by everyday subject matter, such as the mass media and popular materials including advertisements, cartoons, and songs. Artists often included numbers and fragments of words in their pictures. The Cubists also made *collages,* which are paintings that incorporate real objects, such as newspaper clippings, wallpaper, or oilcloth (see **Collage**). In addition, many of the Cubists were strongly influenced by the formal simplification and expressive power of black African sculpture.

Cubist paintings are traditionally described in terms of *analytic Cubism* and *synthetic Cubism.* Analytic Cubism refers to the style that emerged about 1910. Its name suggests the way artists broke down, or *analyzed,* and



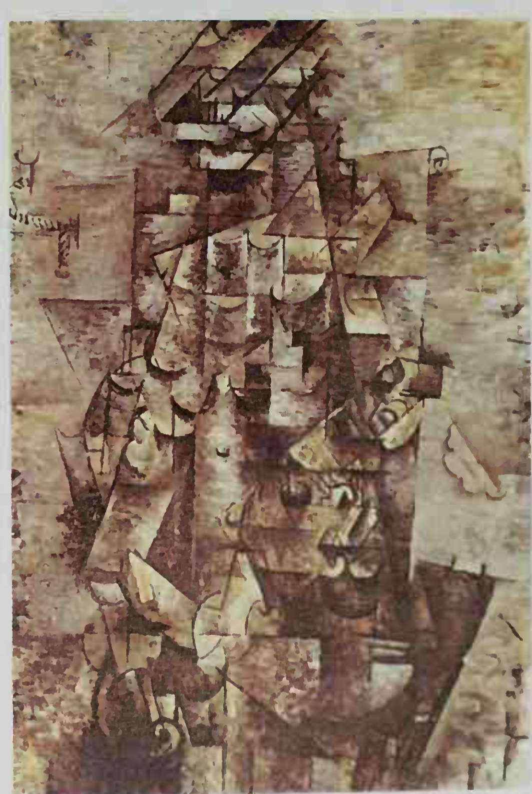
Museum of Modern Art, New York, acquired through the Lillie P. Bliss Bequest

Early Cubism grew from Pablo Picasso's *Les Demoiselles d'Avignon,* of 1907, *shown here.* Black African sculpture influenced it.



The Bottle of Banyuls (1914), a gouache and pencil with paper collage on canvas by Juan Gris. Kunstmuseum Bern, Hermann and Margrit Rupf Collection © COSMOPRESS, Genf

Synthetic Cubism began in 1912. This style of Cubism was more realistic and colorful than the earlier analytic Cubist style.



Museum of Modern Art, New York, acquired through the Lillie P. Bliss Bequest

Analytic Cubism divided objects into fragments and planes, as in Georges Braque's *Man with a Guitar* of 1911, *shown here.*

then reassembled observed forms in various ways. Synthetic cubism refers to the style of 1912 and later, in which artists tried to *synthesize* (combine) imaginative elements into new representational structures.

Although no single painting can be identified as the first cubist picture, Picasso's *Les Demoiselles d'Avignon* (1907) is a landmark in the movement. The series of landscapes Braque painted in the town of l'Estaque, near Marseilles, had a strong geometric character typical of early cubism. Nancy J. Troy

For other examples of cubist painting, see **Painting** (Cubism); **Duchamp, Marcel; Léger, Fernand.** See also **Braque, Georges; Cézanne, Paul; Gris, Juan; Picasso, Pablo; Sculpture** (Cubism and futurism).

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Cubit, *KYOO biht,* is a measure of length used by several early civilizations. It was based on the length of the forearm from the tip of the middle finger to the elbow. No one knows when this measure was established. The length of the arm, or cubit, was commonly used by many early peoples, including the Babylonians, Egyptians, and Israelites. The royal cubit of the ancient Egyptians was about 20 $\frac{3}{5}$ inches (52.3 centimeters) long. That of the ancient Romans was 17 $\frac{1}{2}$ inches (44.5 centimeters). The Israelites' cubit at the time of Solomon was 25 $\frac{1}{5}$ inches (64 centimeters). Richard S. Davis

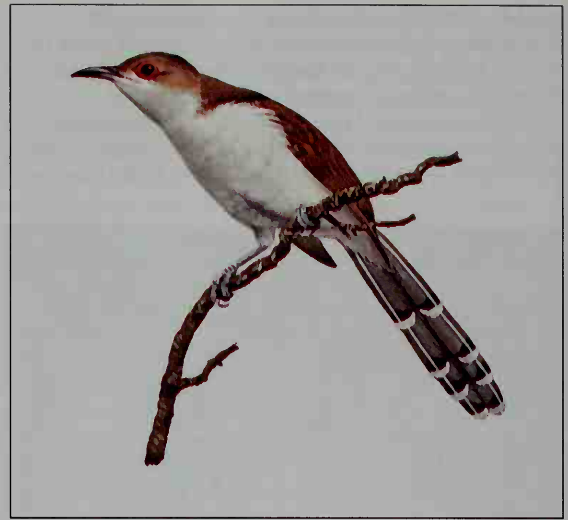
Cuchulainn, *koo KUHL ihn,* also spelled Cuchulain, is a great hero of Irish mythology and folklore. He is the main character in *The Cattle Raid of Cooley,* the oldest epic of western Europe in a native language. It is the central story of the Ulster cycle of ancient Irish tales. Said to have taken place about the time of Jesus Christ, the story has a slim base in fact, but the details are mythological. Cuchulainn's reputation as a warrior grew in folk tales until he came to be treated as a defender of all Ireland. He became a favorite character among writers of the Irish Literary Renaissance of the late 1800's.

Cuchulainn had extraordinary powers because his father was Lugh *(loo),* an important Celtic god. He won the name Cuchulainn (Hound of Culan) by offering to take the place of a ferocious watchdog he had killed at the house of Culan. Janet Egleson Dunleavy

See **Irish literature** (Heroic tales, romances, and sagas); **Mythology** (The Irish cycles).

Cuckoo is any one of a group of related birds found throughout most of the world. The name *cuckoo* comes from the song of the Old World common cuckoo. This song also serves as the basis for the well-known sound of the cuckoo clock. Cuckoos have rather long and slightly curved beaks. They differ from most birds because two of their toes point forward and two backward. In most species of birds, three toes point forward and one toe points backward.

Two common kinds of cuckoos in North America are the *black-billed cuckoo* and the *yellow-billed cuckoo.* Their songs consist of a series of low, mournful, quivering notes. These cuckoos are slender birds about 1 foot (30 centimeters) long. They have long, rounded tails, olive-brown backs, and white breasts. They differ chiefly in the color of the bill. The black-billed cuckoo has a red circle around its eyes, and the yellow-billed cuckoo has larger white marks on its tail.



WORLD BOOK illustration by Trevor Boyer, Linden Artists Ltd.

The black-billed cuckoo has a long, slightly curved black beak and red circles around its eyes. This species is found in North America east of the Rockies.

Black-billed and yellow-billed cuckoos make their homes in woods, thickets, and orchards. They build untidy nests. There may be two to seven eggs in one nest. The eggs are green-blue with a dull surface. The American cuckoos feed on hairy caterpillars and other insect pests that are shunned by other birds. These cuckoos migrate to the tropics for the winter.

The *Old World common cuckoo* is about the same size as American cuckoos. Males and females both have white breasts with dark bars. The head and back of the males are gray, but those of the females are gray or brown. The Old World common cuckoo is found throughout Europe and most of Asia, and in Africa south of the Sahara.

The common cuckoo, like many other Old World species of cuckoos, does not care for its own young. It lays its eggs in another bird's nest and leaves them to be hatched and cared for by the other bird.

Sandra L. Vehrencamp

Scientific classification. The cuckoos are in the cuckoo family, Cuculidae. The scientific name for the yellow-billed cuckoo is *Coccyzus americanus.* The black-billed cuckoo is *C. erythropthalmus.* The Old World common cuckoo is *Cuculus canorus.*

See also **Ani; Bird** (pictures: Birds of forests and woodlands; Birds of Africa; Birds' eggs); **Roadrunner.**

Cuckoo-shrike is the name of a family of about 70 species of songbirds. Cuckoo-shrikes live in Africa, Asia, Australia, and the Pacific Islands. They are not related to either shrikes or cuckoos. But they have notched bills like those of shrikes, and some have barred feathers like those of many cuckoos.

Cuckoo-shrikes range from 5 $\frac{1}{2}$ to 12 $\frac{1}{2}$ inches (14 to 32 centimeters) in length. The birds have a thick cluster of stiff feathers on their rumps. These feathers fall out easily and so help protect cuckoo-shrikes from hawks and other birds that prey on them. A hawk that strikes a



WORLD BOOK illustration by John Dawson

A cuckoo-shrike has a notched bill. Most species have long wings and tails, and feathers that are white and black or gray. The ground cuckoo-shrike, *shown here,* lives in Australia.

cuckoo-shrike on the rump may catch only a mass of feathers instead of the bird itself.

Most cuckoo-shrikes have long wings and tails. The majority of species are varying shades of gray or black, and white. However, some African cuckoo-shrikes have bright areas of yellow, orange, or red. Males of most kinds of minivets—a group of cuckoo-shrike species found in Asia—are black and bright red or orange.

Most cuckoo-shrikes live in tropical woodlands. They eat caterpillars, other insects, and fruit. Flocks of cuckoo-shrikes continually fly from one tree to another in search of food. However, the ground cuckoo-shrike, which lives in the dry interior of Australia, searches for food on the ground.

Cuckoo-shrikes build cup-shaped nests in trees, and, in most cases, lay from two to three eggs. The eggs of most species are greenish, with brown, gray, or violet spots or blotches. Robert B. Payne

Scientific classification. Cuckoo-shrikes make up the family Campephagidae. The scientific name for the ground cuckoo-shrike is *Pteropodocys maxima.*

Cucumber is a common garden vegetable native to southern Asia, but cultivated as an annual in many parts of the world. The cucumber plant is a hairy-stemmed vine that bears many tendrils. Its triangular leaves may have three pointed lobes. The plant bears yellow or whitish flowers on short stems. Its edible fruit, commonly called *cucumber,* may grow from 1 to 36 inches (2.5 to 90 centimeters) long. The pulpy fruit generally contains many seeds, though some types, such as the English type, are seedless. It is covered by a thin, smooth or prickly skin. The fruit's flesh is usually white or yellowish.

Small cucumbers used for pickling are often called *gherkins.* But the true gherkin is another plant closely related to the cucumber. It bears many little spiny fruits shaped like olives.

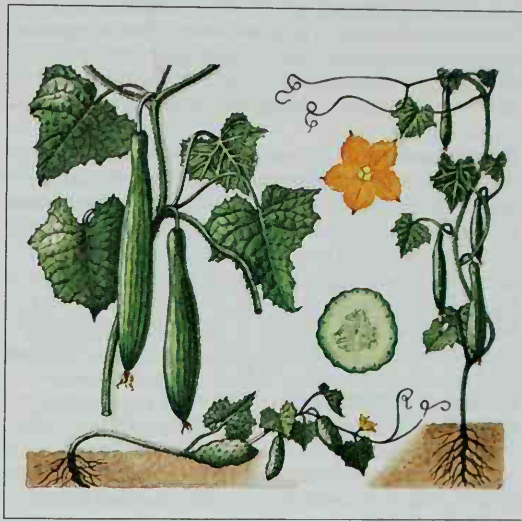
People eat the young cucumber fruits raw or pickle them. The raw fruits are eaten in salads and sandwiches. The mature fruits are tough and contain many hard seeds. They are sometimes pickled or served as a hot vegetable. Cucumbers are a good low-calorie salad item. They are also a good source of iron and calcium, and they provide a moderate amount of vitamins.

Cucumbers grow best in warm weather and are easily killed by frost. Gardeners grow them from seed. They sow the seed in small hills of loam or light soil as soon as warm weather comes. They form the hills about 4 feet (1.2 meters) apart to allow room for the vines to grow. When the plants start to grow, they are thinned so only four or five remain in a hill. The plants grow rapidly in warm weather and if they have enough moisture. Small fruits suitable for pickles appear quite soon. Gardeners pick them every two or three days.

Some cucumbers, particularly the seedless type, are grown in greenhouses. The plants grow much as they do in fields. But usually, because of the limited space, the gardener trains the vines on cords or wires. A cucumber plant frequently yields 100 or more fruits.

Several kinds of beetles attack young cucumber plants. Gardeners often spray the plants with rotenone dust to destroy the insects. The *melon aphid* also attacks cucumber plants and spreads *mosaic,* a virus disease.

Albert Liptay



WORLD BOOK illustration by Christobel King

Cucumbers grow on vines that have many coiled growths called *tendrils.* The plant has triangular leaves and yellow or whitish flowers. Cucumbers are eaten raw or pickled.

Scientific classification. The cucumber is in the gourd family, Cucurbitaceae. It is *Cucumis sativus.* Gherkins are *C. anguria.*

See also Pickle.

Cud is a small mass of food that animals called *ruminants* bring up from their stomachs for a second chewing. Ruminants include antelope, camels, cattle, deer, and goats. See also **Ruminant**; **Cattle** (Stomach).

C. Richard Taylor

Cudahy, *KUHD uh hee,* **Michael** (1841-1910), an American meat packer, developed and introduced cold-storage facilities in packing plants. This made possible year-round meat curing and livestock marketing. Cudahy went to work for a meat packer in Milwaukee

at the age of 14. In 1875, he became a partner in Armour and Company. With P. D. Armour, he formed the Armour-Cudahy Company in 1887. In 1890, he founded the Cudahy Packing Company, one of the largest such companies in the United States, in Omaha, Nebraska.

Cudahy was born in Callan, Ireland, on Dec. 7, 1841, and came to the United States with his parents in 1849. He died on Nov. 27, 1910. William R. Childs

Cuenca, *KWEHNG kah* (pop. 227,212), is a city in the Andes Mountains of southern Ecuador. For Cuenca's location, see **Ecuador** (political map). Cuenca, a commercial center, leads Ecuador in the production of Panama hats. Other important products include cinchona bark, which is used to make drugs; gold; hides of alligators and other animals; and tires. The city has a modern cathedral and a picturesque market where Indians of the region sell their goods. Spaniards founded Cuenca in 1557. Murdo J. MacLeod

Cuernavaca, *KWEHR nuh VAHK uh* (pop. 337,966), is the capital of the state of Morelos in Mexico. It lies about 37 miles (60 kilometers) south of Mexico City (see **Mexico** [political map]). The city's mild climate and beautiful scenery have made it a popular resort. The city has many beautiful estates and ancient buildings. Tourist attractions include the Palace of Cortes and the Borda gardens. The Spaniards founded the city in 1521.
James D. Riley

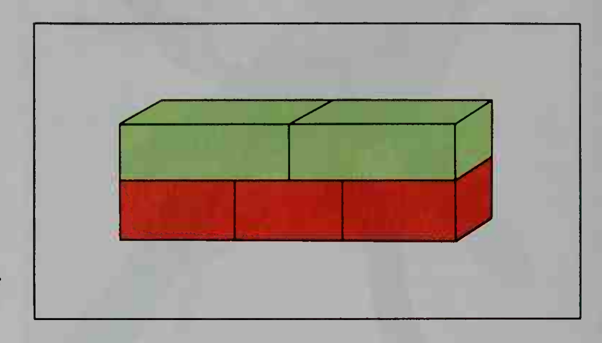
Cuffe, Paul (1759-1817), an American seaman and merchant, encouraged the colonizing of blacks in Sierra Leone, Africa, after sailing there in 1810. He financed the voyage of 38 free blacks in 1815. He also sought to strengthen the legal position of blacks in the United States. His efforts led to a law in 1783 that gave blacks in Massachusetts the right to vote. Cuffe, part black and part Indian, was born on Jan. 17, 1759, on Cuttyhunk Island, Massachusetts. He also preached among his fellow Quakers. He died on Sept. 9, 1817. Richard D. Brown

Cuisenaire Method, *KWIHZ uh NAIR,* is a teaching system designed to help students discover basic mathematical principles by themselves. The method uses rods of 10 different colors and lengths that are easy to handle. By using the rods, students can prove numerical relationships and understand principles of proportion. Students can also use the rods in learning addition, subtraction, multiplication, division, factoring, and fractions.

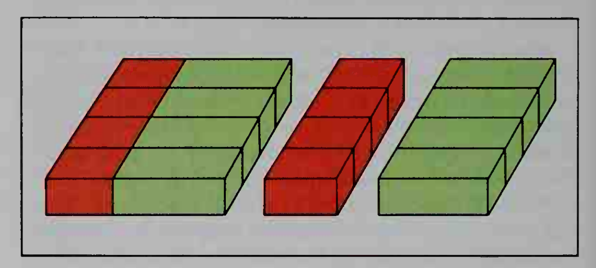
The rods help the student understand mathematical principles rather than merely memorize them. For example, two white rods placed end to end are the same length as a red rod. The red rod then stands for the number 2 if the white rod represents 1. A red rod and a white rod placed end to end are as long as a light-green rod. The light-green rod then stands for 3, because it is as long as three white rods. The rods can also be used to represent different sets of numbers. For example, if the white rod is assigned a value of 3, the red rod becomes 6.

Students can discover many facts about mathematical relationships by working with the rods. For example, three red rods placed end to end are as long as one dark-green rod. The dark-green rod is two-thirds as long as a blue rod. Students can see that the three red rods equal two-thirds of a blue rod.

The rods also can be used to teach such elementary arithmetic properties as the associative, commutative, and distributive properties. For instance, to help students understand that $3 \times 2 = 2 \times 3$, an example of the commutative property, two light-green rods can be placed on top of three red rods, as shown below.



To show that $4 \times (2 + 3) = (4 \times 2) + (4 \times 3)$, an example of the distributive property, a set of four red rods and four light-green rods can be split into two sets. One of the two sets would have four red rods. The other would have four light-green rods. See the illustration below.



Schoolteachers use the Cuisenaire Method in the United States, Canada, and parts of Europe. Emile-Georges Cuisenaire, a schoolteacher from Thuin, Belgium, developed the method. Jeffrey C. Barnett

Cukor, *KOO kuhr,* **George** (1899-1983), was an American motion-picture director. He became noted for his ability to draw superior performances from many of Hollywood's leading actresses. Cukor directed Greta Garbo in *Camille* (1937), Katharine Hepburn in *The Philadelphia Story* (1940), Judy Holliday in *Born Yesterday* (1950), and Judy Garland in *A Star Is Born* (1954). He won an Academy Award for directing *My Fair Lady* (1964). Cukor directed or co-directed about 50 films from 1930 to 1981. He died on Jan. 24, 1983.

Cukor was born on July 7, 1899, in New York City. He directed plays on Broadway before going to Hollywood in 1929. During the 1930's, he made several films based on literary classics, including *Little Women* (1933) and *David Copperfield* (1935). Cukor also directed the popular comedies *Adam's Rib* (1949) and *Pat and Mike* (1952), both of which co-starred Katharine Hepburn and Spencer Tracy. Cukor's other films include *A Bill of Divorcement* (1932), *Holiday* (1938), *The Women* (1939), and *Travels with My Aunt* (1972). John F. Mariani

Cullen, Countee, *kown TAY* or *kown TEE* (1903-1946), was a black poet and novelist known for his lyrical poetry. He established his reputation with his first pub-

lished collection of poems, *Color* (1925). His other books of poetry include *Copper Sun* (1927) and *The Black Christ* (1929). He collected the poems by which he wished to be remembered in *On These I Stand* (1947). Cullen's novel *One Way to Heaven* (1932) satirizes high society in the Harlem section of New York City. He and Arna Bontemps, a black American author, wrote the musical play *St. Louis Woman* (1946). Cullen also wrote two children's books, *The Lost Zoo* (1940) and *My Lives and How I Lost Them* (1942).

Cullen was born in New York City. He graduated from New York University and earned an M.A. in English literature from Harvard University. He spent much of his later life teaching. William L. Andrews

Cult is the term commonly used for a new religious group devoted to a living leader and committed to a fixed set of teachings and practices. Such groups range in size from a few followers to worldwide organizations directed by a complex chain of command. Members of these groups generally consider them to be legitimate religions and rarely call them cults. Most historians of religion use the more neutral term *new religious movement* instead of *cult.*

Because there is no one definition of cults, their number and membership today cannot be accurately measured. According to some estimates, 3,000 cults exist throughout the world. These cults claim a total estimated membership of more than 3 million people, mostly young adults.

Kinds of cults. Traditionally, the term *cult* referred to any form of worship or ritual observance, or even to a group of people pursuing common goals. Many groups accepted as religions today were once classified as cults. Christianity began as a cult within Judaism and developed into an established religion. Other groups that began as cults and developed into organized churches include the Quakers, Mormons, Swedenborgians, Christian Scientists, Methodists, Jehovah's Witnesses, and Seventh-day Adventists. The Amish, who trace their history to the 1500's, are an example of a cult that has changed little over the centuries. For a discussion of cults in the ancient world, see Mysteries.

Since the 1960's, publicity about cults has altered the meaning of the term. Today, the term is applied to groups that follow a living leader who promotes new and unorthodox doctrines and practices. Some leaders demand that members live apart from everyday society in communities called *communes.* Leaders claim that they possess exclusive religious truth, and they command absolute obedience and allegiance from their followers. Some cults require that members contribute all their possessions to the group.

Modern cults. Probably the most notorious United States cult of the late 1900's was the People's Temple, a group led by Jim Jones, a Protestant clergyman. Hundreds of his followers moved into a rural commune called Jonestown in the South American country of Guyana. They lived under Jones's absolute rule. In 1978, cult leaders killed a U.S. congressman and three journalists investigating activities in Jonestown. Jones then ordered his followers to commit suicide, resulting in the deaths of over 900 people. See Guyana (History).

Another notorious cult was the Branch Davidians, led by a self-proclaimed prophet named David Koresh. In 1993, a 51-day confrontation between the cult and federal forces near Waco, Tex., ended with the apparent mass suicide of over 80 cult members, including Koresh.

Some movements regarded as cults did not begin as religious groups. A movement called Synanon was originally organized in California to rehabilitate drug addicts. It changed into a commune that won legal recognition as a religion.

Two of the largest groups regarded as cults in the United States began in Asia. The International Society for Krishna Consciousness, commonly called the Hare Krishna movement, came from India in 1954. During the 1960's and 1970's, its leader, Swami Bhaktivedanta, established many centers in the United States and other countries. Most members of Hare Krishna wear orange robes similar to those worn by Indian holy men. The men shave their heads, and members meditate in strictly regulated communes.

The Unification Church, led by its Korean founder, the evangelist Sun Myung Moon, is an adaptation of Christianity. Its members, commonly called "Moonies," believe in a cosmic struggle between the forces of good and the forces of evil, represented by international Communism. The Unification Church has been aggressive in seeking conversions. Like many other cults popular in the 1970's, however, they began to adopt a more moderate tone in the 1980's.

Less aggressive and more loosely organized cults tend to stress personal, individual meditation. Transcendental Meditation and Zendo offer forms of meditation. See Transcendental Meditation. Mark Juergensmeyer

See also Divine, Father.

Additional resources

Barrett, David V. *The New Believers: A Survey of Sects, Cults and Alternative Religions.* Rev. ed. Cassell, 2001.
Jenkins, Philip. *Mystics and Messiahs: Cults and New Religions in American History.* 2000. Reprint. Oxford, 2001.
Lewis, James R., ed. *Odd Gods.* Prometheus, 2001.
Melton, J. Gordon. *Encyclopedic Handbook of Cults in America.* Rev. ed. Garland, 1992.

Cultural anthropology. See Anthropology.

Cultural lag is the failure of certain parts of a culture to keep up with other, related parts. William F. Ogburn, an American sociologist, introduced the term in the 1920's. He noted that the development of technology caused rapid changes in *material culture,* including housing, machinery, and industrial processes. But he observed that *nonmaterial culture,* including ideas, values, and social systems, often lagged behind material culture.

According to Ogburn, many social problems result from cultural lag. For example, new inventions may replace many workers. The time it takes these workers to learn new skills and find other jobs is a cultural lag that results in unemployment.

Today, social scientists realize that changes in ideas and social systems may sometimes occur before changes in technology. For example, the people of a poor country may begin to value life styles common in a wealthy country before their material culture can support such life styles. Jennie Keith

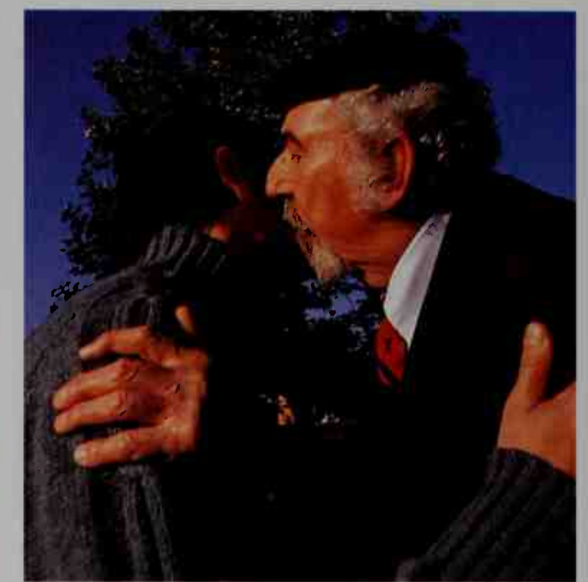
See also Culture (How cultures change).

Cultural Revolution. See China (The Cultural Revolution).



© Vic Bider, Tony Stone Images

Two Americans shake hands in greeting.



© Van Bucher, Photo Researchers

Two Europeans greet with a kiss on the cheek.

Customs differ from culture to culture. The photographs above and on the next page illustrate some of the different ways that people greet each other in various parts of the world.

Culture

Culture is a term used by social scientists for a way of life. Every human society has a culture. Culture includes a society's arts, beliefs, customs, institutions, inventions, language, technology, and values. A culture produces similar behavior and thought among most people in a particular society. To learn about a culture, one may ask such questions as these: What language do the people speak? What do the people of the society wear? How do they prepare their food? What kind of dwellings do they live in? What kind of work do they do? How do they govern themselves? How do they judge right from wrong?

People are not born with any knowledge of a culture. They generally learn a culture by growing up in a particular society. They learn mainly through the use of language, especially by talking and listening to other members of the society. They also learn by watching and imitating various behaviors in the society. The process by which people—especially children—learn their society's culture is called *enculturation.* Through enculturation, a culture is shared with members of a society and passed from one generation to the next. Enculturation unifies people of a society by providing them with common experiences.

The term *culture* has been defined in many ways. It often is used in a narrow sense to refer to activities in such fields as art, literature, and music. In that sense, a *cultured person* is someone who has knowledge of and appreciation for the fine arts. But under the broader definition used by social scientists, culture includes all areas of life, and all human beings have a culture.

Social scientists identify certain aspects of culture as *pop culture* or *popular culture.* Pop culture includes such elements of a society's arts and entertainment as television, radio, recordings, advertising, sports, hobbies, fads, and fashions.

The term *civilization* is similar to culture, but it refers mostly to cultures that have complex economic, governmental, and social systems. A civilization is technologically more advanced than other cultures of its time. A culture is any way of life, be it simple or complex, advanced or not advanced.

For hundreds of thousands of years, human beings have had at least some of the biological abilities on which culture depends. These abilities are to learn, to use language and other symbols, and to employ tools to organize their lives and adapt to their environments. Besides human beings, other animals also have such elements of culture as the ability to make and use tools and the ability to communicate. For example, elephants break off tree branches and wave them with their trunks to brush off flies. Dolphins communicate with one another by means of barks, whistles, and other sounds. But no other animals have developed language and other symbols as complex as those of human beings. Thus, no other animal possesses to the same extent the abilities to learn, to communicate, and to store, process, and use information. The rest of this article focuses on the main aspects of human culture.

Conrad Phillip Kottak, the contributor of this article, is a Professor of Anthropology at the University of Michigan. He is the author of several books, including Anthropology: The Exploration of Human Diversity *and* Assault on Paradise: Social Change in a Brazilian Village.

Characteristics of culture

There are several important characteristics of culture. The main ones are these: (1) A culture satisfies human needs in particular ways. (2) A culture is acquired



© Charles Gupton, Tony Stone Images

Two Asians greet each other with a bow.

through learning. (3) A culture is based on the use of symbols. (4) A culture consists of individual *traits* and groups of traits called *patterns.*

Satisfying basic needs. All cultures serve to meet the basic needs shared by human beings. For example, every culture has methods of obtaining food and shelter. Every culture also has family relationships, economic and governmental systems, religious practices, and forms of artistic expression.

Each culture shapes the way its members satisfy human needs. Human beings have to eat, but their culture teaches them what, when, and how to eat. For example, many British people eat smoked fish for breakfast, but many Americans prefer cold cereals. In the Midwestern United States, people generally eat dinner at 5 or 6 p.m. However, most Spaniards dine at 10 p.m. Many Turks prefer strong coffee with the grounds left in the cup, but most Australians filter out the grounds for a weaker brew. Many Japanese eat their meals from low tables while sitting on mats on the floor. Canadians usually sit on chairs at higher tables.

Learning. Culture is acquired through learning, not through biological inheritance. That is, no person is born with a culture. Children take on the culture in which they are raised through enculturation.

Children learn much of their culture through imitation and experience. They also acquire culture through observation, paying attention to what goes on around them and seeing examples of what their society considers right and wrong. Children also may absorb certain aspects of culture unconsciously. For example, Arabs tend to stand closer together when speaking to one another than most Europeans do. No one instructs them to do so, but they learn the behavior as part of their culture.

Children also learn their culture by being told what to do. For example, a parent tells a son or daughter, "Say thank you" or "Don't talk to strangers." Individual members of a particular culture also share many memories, beliefs, values, expectations, and ways of thinking. In fact, most cultural learning results from verbal communication. Culture is passed from generation to generation chiefly through language.

Using symbols. Cultural learning is based on the ability to use symbols. A symbol is something that stands for something else. The most important types of symbols are the words of a language. There is no obvious or necessary connection between a symbol and what it stands for. The English word *dog* is a symbol for a specific animal that barks. But other cultures have a different word that stands for the same animal—the French word *chien,* for example, or the Swahili word *mbwa.*

There are many other kinds of symbols besides the words in a language. A flag, for example, stands for a country. Colors have symbolic meaning, and the meanings vary from culture to culture. For Chinese people, white is a color of mourning. In Western societies, black is the color of mourning. White is a symbol of purity, and brides wear white. All human societies use symbols to create and maintain culture.

Forming patterns. Cultures are made up of individual elements called *cultural traits.* A group of related traits is a *cultural pattern.*

Cultural traits may be divided into *material culture* and *nonmaterial culture.* Material culture consists of all the things that are made by the members of a society. It includes such objects as buildings, jewelry, machines, and paintings. Nonmaterial culture refers to a society's behaviors and beliefs. A handshake, a marriage ceremony, and a system of justice are examples of nonmaterial culture.

Cultural patterns may include numerous traits, both material and nonmaterial. The pattern for agriculture, for example, includes the time when crops are harvested (nonmaterial), the methods (nonmaterial) and machinery (material) used in harvesting, and the structures for storing the crops (material).

Most traits that make up a cultural pattern are connected to one another. If one custom, institution, or value that helps form a cultural pattern changes, other parts of the pattern will probably change, too. For example, until the 1950's, the career pattern for most women in Western societies was to work full-time as homemakers and mothers. By the late 1900's, the pattern was for most women to get jobs outside the home. As part of the new pattern, attitudes about marriage, family, and children also changed. The new pattern includes marriage at a later age than ever before, a dependence on alternative child-care systems, and more frequent divorce.

The boundaries of cultures

Every human society has a culture. People who grow up in the same nation can be said to share a *national culture.* But they may be part of other societies within the nation that have separate cultural traditions.

Social scientists sometimes use the term *subculture* to describe variations within a culture. Social groups often develop some cultural patterns of their own that set them apart from the larger society they are part of.

Subcultures may develop in businesses, ethnic groups, occupational groups, regional groups, religious groups, and other groups within a larger culture. For example, Amish people in Pennsylvania and several Midwestern States make up a subculture, as do members of a teenage street gang.

Many cultural traits and patterns are limited to a particular culture, but many others are common to more than one culture. For example, cultures in the same part of the world often have similar patterns. A geographical region in which two or more cultures share cultural traits and patterns is called a *culture area.* Northern Europe is an example of a culture area.

Some cultural traits have spread throughout the world. For example, some clothing, music, sports, and industrial processes are the same in many areas of the world. Cultural traditions that extend beyond national boundaries form what is called *international culture.* For example, countries that share an international culture include Australia, Canada, the United Kingdom, and the United States. Their common cultural traditions include the English language and a heritage of British founders.

Culture and society

Multiculturalism. Some societies—such as those of Tibetans in Tibet and various peoples of the Pacific Islands—have traditionally been associated with a single culture. Other societies—such as those of the United States and Canada—are multicultural societies. They include many distinct cultures.

A shared cultural background makes people feel more comfortable with other people from their own culture. Many people initially may feel confused and uneasy when they deal with people of another culture. The discomfort that people often feel when they have contact with an unfamiliar culture is called *culture shock.* Culture shock usually passes if a person stays in a new culture long enough to understand it and get used to its ways.

People of one culture who move to a country where another culture dominates may give up their old ways and become part of the dominant culture. The process by which they do this is called *assimilation.* Through assimilation, a minority group eventually disappears because its members lose the cultural characteristics that set them apart. In a multicultural society, however, assimilation does not always occur.

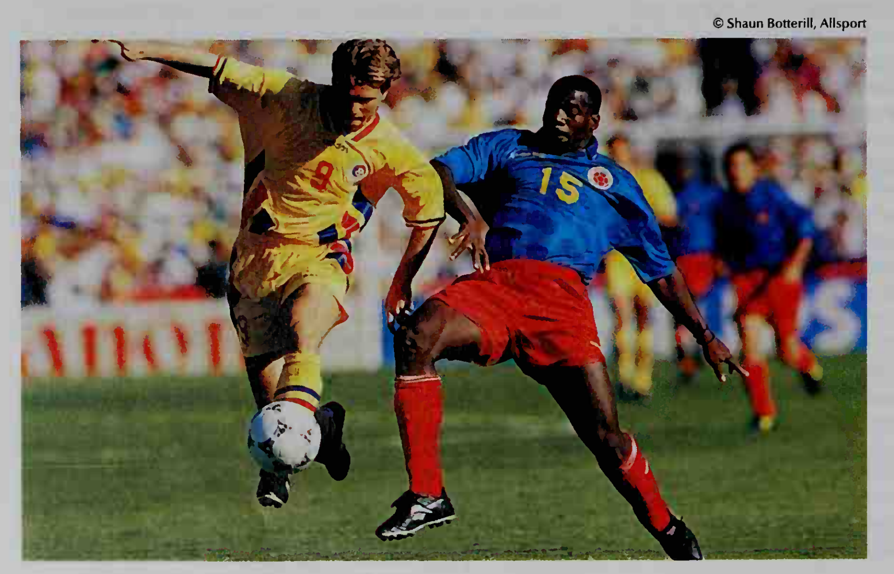
A multicultural society supports the view that many distinct cultures are good and desirable. The multicultural view encourages such diversity. Thus, in the United States, millions of people speak both English and the language of their own culture. They eat both American food (apple pie and hamburgers) and ethnic food. They celebrate both national holidays (Fourth of July and Thanksgiving) and their ethnic holidays. For example, many Mexican Americans celebrate Mexican Independence Day on September 16. In Chinese communities across the country, parades and other festivities mark the Chinese New Year.

Multiculturalism succeeds best in a society that has many different ethnic groups and a political system that promotes freedom of expression and awareness and understanding of cultural differences. Ethnic groups can bring variety and richness to a society by introducing their own ideas and customs. However, ethnic groups that keep their own values and traditions can also threaten national unity. In many parts of the world, neighboring ethnic groups dislike and distrust one another. In some cases, these feelings have even led to war. In Bosnia-Herzegovina, for example, a civil war broke out in the early 1990's between Serbs and non-Serbs, who included Bosnian Muslims and Croats.

Ethnocentrism and cultural relativism. Many people in all cultures think that their own culture is right, proper, and moral. They tend to use their own cultural standards and values to judge the behavior and beliefs of people from different cultures. They regard the behavior and beliefs of people from other cultures as strange or savage.

The attitude that one's culture is best is called *ethnocentrism.* Ethnocentrism is harmful if carried to extremes. It may cause prejudice, automatic rejection of

© Shaun Botterill, Allsport



Soccer, the world's most popular sport, is played by millions of people from many different cultures. Some cultural traits are common to one or a few cultures, but others—like soccer—have spread beyond such boundaries and have become part of what is called *international culture.*

ideas from other cultures, and even persecution of other groups.

The opposite view of ethnocentrism is called *cultural relativism.* It contends that no culture should be judged by the standards of another. This view can also present problems if carried to extremes. An extreme cultural relativist would say there is no such thing as a universal morality. An extreme cultural relativist would argue that the rules of all cultures deserve equal respect, even rules that allow such practices as cannibalism and torture. But many social scientists would reply that certain values are common to all societies—a prohibition against incest, for example, and support for marriage. They would argue that international standards of justice and morality should not be ignored.

How cultures change

Every culture changes. But all parts of a culture do not change at the same time. For example, science and technology may sometimes change so rapidly that they lessen the importance of customs, ideas, and other nonmaterial parts of a culture. At other times, changes in ideas and social systems may occur before changes in technology. The failure of certain parts of a culture to keep up with other, related parts is referred to as *cultural lag.*

A number of factors may cause a culture to change. The two main ones are (1) contact with other cultures and (2) invention.

Contact with other cultures. No society is so isolated that it does not come in contact with other societies. When contact occurs, societies borrow cultural traits from one another. As a result, cultural traits and patterns tend to spread from the society in which they originated. This spreading process is called *diffusion.* Corn growing, for example, began in what is now Mexico thousands of years ago and eventually spread throughout the world.

Diffusion can occur without firsthand contact between cultures. Products or patterns may move from group A to group C through group B without any contact between group A and group C. Today, diffusion is rapid and widespread because many cultures of the world are linked through advanced means of transportation and communication.

When two cultures have continuous, firsthand contact with each other, the exchange of cultural traits is called *acculturation.* Acculturation has often occurred when one culture has colonized or conquered another, or as a result of trade. In addition to adopting each other's traits, the two cultures may blend traits. For example, if the people of the cultures speak different languages, they may develop a mixed language called *pidgin* in order to communicate. The cultures may also exchange or blend such traits as clothing, dances, music, recipes, and tools. Through acculturation, parts of the culture of one or both groups change, but the groups remain distinct. In this way, acculturation differs from assimilation. Through assimilation, one group becomes part of another group and loses its separate identity.

Invention is the creation of a new device, process, or product. Inventions provide a new solution to an old or new problem. Without inventions, human beings would be at the mercy of the climate and the land. Inventions have given people much control over their environment and enabled them to lead easier lives.



Young students use a computer as an educational tool. The invention of the computer has had enormous impact on modern life. Inventions are a major cause of cultural change.

Inventions have led to many changes in a culture. The invention of agriculture, for example, made it possible for people to settle in farm villages. Their values and social organization changed. They placed importance on using land and animals to produce crops. They began to build permanent housing. They developed systems of irrigation and a number of tools.

The invention of spinning and weaving machines and an improved steam engine in the 1700's produced another great change in the way people lived. These inventions led to the opening of factories. Many people who had worked at home in rural areas flocked to the cities to work in the new factories. As cities became more crowded, new kinds of political, economic, and social systems developed.

The invention of the electronic computer in the mid-1900's has had enormous impact. It has brought far-reaching changes in communication, education, entertainment, and numerous other areas of modern life.

How people study culture

The scientific study of human beings is called *anthropology.* One of the main branches of anthropology is cultural anthropology, which studies human cultures. The work of cultural anthropologists is *comparative* and *cross-cultural*—that is, cultural anthropologists study various societies to determine their cultural similarities and differences.

Cultural anthropologists study the artwork, houses, tools, and other material products of contemporary cultures. They also investigate the nonmaterial creations, including social groups, religious beliefs, symbols, and values. They gather information primarily by living for a time among the people they are studying and by observing them and talking with them. They organize the information into a scientific description called an *ethnography.*

Another main branch of anthropology is archaeology. It focuses on cultures of the past. Archaeologists study the remains of these cultures, including buildings, clothing, pottery, tools, and artwork. They trace the



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Archaeologists analyze a mound of garbage to learn about contemporary American life. Social scientists use a variety of methods to study past and present human cultures.

development of cultures by examining the things the people made and used. Archaeologists work at a specific site. They dig carefully for buried objects in a process called *excavation.* They describe whatever they find and take photographs of representative samples.

Archaeological research is the chief method available for learning about societies that existed before the invention of writing about 5,500 years ago. However, some archaeologists study later cultures, even contemporary cultures. For example, an archaeological project begun in 1973 in Tucson, Arizona, has provided information about contemporary American life through a study of people's garbage.

Other social scientists who study aspects of culture include sociologists and political scientists. They work mainly in a single urban, industrial society, and they make cross-cultural comparisons less often than anthropologists. Conrad Phillip Kottak

Related articles in *World Book.* See **Anthropology** and its list of *Related articles.* See also:

Assimilation
City (Cultural variety in cities)
Civilization
Communication (Communication and culture)
Cultural lag
Custom
Ethnic group
Ethnocentrism
Etiquette
Folklore
Human rights (Human rights and cultural differences)
Language
Mores
Multiculturalism
Prehistoric people (Cultural development after *Homo erectus)*
Sexuality (Cultural factors; Cultural influences)
Social change
Socialization

Outline

I. **Characteristics of culture**
   A. Satisfying basic needs
   B. Learning
   C. Using symbols
   D. Forming patterns
II. **The boundaries of cultures**
III. **Culture and society**
   A. Multiculturalism
   B. Ethnocentrism and cultural relativism
IV. **How cultures change**
   A. Contact with other cultures
   B. Invention
V. **How people study culture**

Questions

What is enculturation?
What are the two main causes of cultural change?
How does the use of the term *culture* in a narrow sense differ from the broader definition used by social scientists?
What is a culture area?
Under what conditions does multiculturalism succeed best?
What are the most important types of symbols?
How can one deal with culture shock?
What is the difference between a cultural trait and a cultural pattern?
In what ways can ethnocentrism be harmful?
How does acculturation differ from assimilation?

Additional resources

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Chiarelli, Brunetto, and Bebi, A. L. *The Atlas of World Cultures.* Bedrick, 1997. Younger readers.
Galens, Judy, and others, eds. *Gale Encyclopedia of Multicultural America.* 2 vols. Gale, 1995.
Harris, Marvin. *Culture, People, Nature.* 7th ed. Longman Pub. Group, 1997.
Levinson, David, ed. *The Encyclopedia of World Cultures.* 10 vols. G. K. Hall, 1991-1994.
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Culture, in biology, is a growth of microorganisms or cells produced under controlled conditions in a laboratory. Microorganisms grown in cultures include bacteria, viruses, and yeasts. A culture of plant or animal cells is known as a *cell culture.*

Cultures require sterile conditions to prevent contamination, and a suitable *culture medium* (substance that provides nutrients). A cell culture will grow and multiply if the culture medium meets its nutritional needs. If the *primary culture* becomes too crowded, the scientist can transfer part of the cells to a *secondary culture.* Cells ordinarily divide only a limited number of times and then die. Occasionally, however, a mutation occurs that enables them to grow indefinitely.

Cell cultures show how cells grow and function normally and thus help scientists understand more about cell abnormalities that occur in cancer and other diseases. Cultures of microorganisms assist doctors in diagnosing diseases. For example, bacteria or viruses found in mucus or body tissue can be grown in a culture for identification. Cultures also are used to produce antibiotics, vaccines, and other drugs.

Mary Lee S. Ledbetter

Culture shock. See **Culture** (Culture and society).

Cum laude. See **Degree, College.**

Cumberland Gap is a natural pass in the Appalachian Mountains, near the meeting point of Kentucky, Tennessee, and Virginia. The gap cuts a notch about 600 feet (180 meters) deep into Cumberland Mountain. The gap is about 1,600 feet (490 meters) higher than sea level. Early pioneers used the gap as a passage into the Cumberland Mountains and the Appalachian Plateau to the west.

An exploring party led by the pioneer scout Thomas Walker used the Cumberland Gap in 1750. In 1775, the famous pioneer Daniel Boone blazed the Wilderness Road through the gap (see **Boone, Daniel**). Between 1775 and 1800, about 200,000 people crossed the

gap. The gap was controlled alternately by the Confederate and Union armies during the American Civil War (1861-1865). Cumberland Gap National Historical Park covers about 20,000 acres (8,000 hectares) and is one of the country's largest historical parks. Karl B. Raitz

Cumberland Mountains, part of the Appalachian Mountain system, extend across part of eastern Tennessee and Kentucky, and form the boundary between Virginia and Kentucky. Some geographers call this mountain region the Cumberland Plateau. Streams have carved a complex pattern of narrow, steep-sided valleys into the mountains. The Cumberlands rise from 2,000 to 3,000 feet (610 to 910 meters) above sea level. The mountains contain rich coal fields. See also **Appalachian Mountains.** E. Willard Miller

Cumberland River, a branch of the Ohio River, rises in the Cumberland Mountains in eastern Kentucky. From there, it winds southwestward into central Tennessee, then northwestward into western Kentucky. It empties into the Ohio at Smithland, Kentucky. The Cumberland is about 690 miles (1,100 kilometers) long and drains an area of about 18,000 square miles (46,600 kilometers). It drops 68 feet (21 meters) at Cumberland Falls, now part of a state park in southern Kentucky. Below the falls, the river is dammed by Wolf Creek Dam. The river is navigable from the dam to the Ohio, a distance of about 460 miles (740 kilometers). The main cities on the Cumberland are Nashville and Clarksville, Tennessee. The Big South Fork National River and Recreation Area lies along the river's South Fork. See also **Ohio River** (map).

Karl B. Raitz

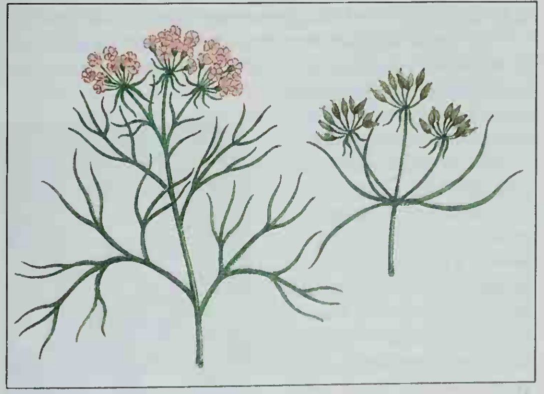
Cumberland Road. See National Road.

Cumin, *KUHM uhn, KOOM uhn,* or *KYOOM uhn,* is a small herb grown for its fruit. The dried fruit, commonly called *cumin seed,* is primarily used to season foods. The plant, native to the Mediterranean region, is cultivated commercially in Europe, the Middle East, Africa, and Asia. The cumin plant grows about 6 inches (15 centimeters) high. It bears clusters of white or rose-colored flowers and yellowish-brown fruit. The plant grows best in a mild climate and in rich, well-drained soil. As an *annual,* it lives for only one growing season.

Cumin seeds have a strong, spicy taste similar to that of caraway seeds. Cumin provides the main flavor in most Egyptian, Indian, and Turkish curries. It also is used to flavor many Mexican dishes, cheeses, sausages, stews, soups, pickles, meats, and dressings. The fruit yields an oil used in perfumes and alcoholic beverages.

Lyle E. Craker

Scientific classification. Cumin belongs to the parsley family, Apiaceae or Umbelliferae. The scientific name for cumin is *Cuminum cyminum.*



WORLD BOOK illustration by Lorraine Epstein

The cumin plant bears clusters of small flowers, *left.* The fruit, *right,* is dried and used to season foods.

Cummings, E. E. (1894-1962), was one of the most innovative poets in American literature. He is especially known for violating the rules of composition, rejecting punctuation and capitalization, distorting *syntax* (sentence structure), and experimenting with *typography* (the arrangement of printed matter). He wrote his own name as e. e. cummings. However, Cummings's themes and even many of his forms are traditional. Beneath his poems' complex surfaces are relatively simple, straightforward ideas. Cummings emphasized the supremacy of the individual over society, and he criticized the tendency of people to conform to socially accepted values and opinions. His poems show him to be joyous and childlike, a believer in love and spontaneity.



Marion Morehouse

E. E. Cummings

Edward Estlin Cummings was born in Cambridge, Massachusetts. He studied at Harvard University, earning a B.A. degree in 1915 and an M.A. degree in 1916. During World War I (1914-1918), Cummings served as a volunteer ambulance driver in France. French authorities suspected him of expressing treasonous views and held him in a French detention camp for three months. Cummings vividly described this experience in his book *The Enormous Room* (1922). Cummings published his first book of poems, *Tulips and Chimneys,* in 1923. In addition to his poetry, Cummings wrote verse plays such as *Him* (1928); *Eimi* (1933), an account of a visit to the Soviet Union; and *i: six nonlectures* (1953), lectures originally delivered at Harvard. His *Complete Poems, 1904-1962* was published in 1991. Bonnie Costello

See also **Poetry** (Rhythm and meter).

Additional resources

Berry, Skip L. *E. E. Cummings.* Creative Education, 1993.
Kennedy, Richard S. *Dreams in the Mirror: A Biography of E. E. Cummings.* Rev. ed. Norton, 1994. *E. E. Cummings Revisited.* Twayne, 1994.

Cumulus. See Cloud.

Cunard, Sir Samuel (1787-1865), founded the Cunard line of steamships. In 1838, he became the chief founding investor of the North American Royal Mail Steam Packet Company, known as the Cunard line. The company provided semimonthly mail and passenger service between England and America. The *Britannia* made the company's first voyage in 1840. Cunard was made a baronet for services the Cunard lines rendered to the United Kingdom in the Crimean War (1853-1856). He was born in Halifax, Nova Scotia. James C. Bradford

Examples of cuneiform writing

Meaning	Outline character about 3000 B.C.	Cuneiform about 2000 B.C.	Assyrian about 700 B.C.	Babylonian about 700 B.C.
The Sun				
God or Heaven				
Mountain				
Man				
Ox				
Fish				

Cuneiform, *kyoo NEE uh fawrm,* was a system of writing used by the people of ancient Middle Eastern civilizations. It became widespread long before the development of modern alphabets. The word *cuneiform* comes from the Latin word *cuneus,* meaning *wedge.* Cuneiform characters are made up of small wedges, each of which is broad at one end and pointed at the other. Most cuneiform writings were inscribed on rectangular clay tablets. The characters were made with a wedge-shaped tool called a *stylus,* while the clay was still wet. The tablets were then dried in the sun. The characters also were inscribed in metal and stone.

Scholars have had difficulty translating cuneiform writing because many of the characters represent either words or syllables. In addition, many ancient peoples developed their own interpretations of cuneiform symbols, and so one character may have several meanings.

Cuneiform was probably developed by the Sumerian people as a shortened form of picture writing. The earliest known cuneiform inscriptions were found in the lower Tigris-Euphrates Valley in what is now southeastern Iraq. They date from about 3000 B.C. The most recent cuneiform clay tablet was written about A.D. 75, near the beginning of the Christian Era.

Sumerian cuneiform symbols are more complex than those of other peoples. The Sumerians and Babylonians used about 600 characters, which ranged from a single wedge to complicated signs consisting of 30 or more wedges. The Hittites used about 350 characters, the Elamites about 200, and the Persians only 39.

Scholars first attempted to translate cuneiform writing in the late 1700's. At that time, European travelers became interested in a cuneiform inscription discovered in western Iran. This inscription was written in three languages—Persian, Babylonian, and Elamite—and measured about 300 feet (91 meters) long. It was carved in a cliff called Behistun Rock. During the mid-1800's, Sir Henry Rawlinson, an English diplomat, first translated the Persian portion and later the Babylonian portion. The text described the accomplishments of the Persian king Darius I in the late 500's B.C. The Elamite section was translated much later. The translations helped scholars decipher other cuneiform inscriptions.

Since 1800, several hundred thousand cuneiform clay tablets and stone inscriptions have been discovered. These inscriptions, on exhibit in museums throughout the world, help scholars broaden their knowledge about early human history. Leonard H. Lesko

See also Communication (picture: Cuneiform writing).

Cunha, *KOO nyuh,* **Euclides da** (1866-1909), a Brazilian newspaper reporter, wrote perhaps the greatest work in Brazilian literature. The book, *Os Sertões* (1902), has been translated as *Rebellion in the Backlands.*

In *Os Sertões,* da Cunha realistically described an armed rebellion that occurred in 1896 and 1897. In this rebellion, Brazilians of the poverty-stricken *sertão* (backlands) fought against the government. Da Cunha witnessed the rebellion as a newspaper correspondent. *Os Sertões* combines journalistic reporting with certain features of a novel, such as characterization, drama, and pacing. The book gives a vivid account of guerrilla warfare. It also provides a sociological study of Brazilian society and its problems. The author attacked Brazilian society for its neglect of the people of the sertão. *Os Sertões* helped the wealthy residents of the coastal region understand the people of the sertão. Da Cunha was born in the state of Rio de Janeiro. Earl E. Fitz

Cunningham, Merce (1919-), is an American dancer and *choreographer* (dance creator). Cunningham often creates dances without advance knowledge of the music and the set designs that will accompany them. He became particularly known for his methods of *chance composition.* For example, in choreographing a dance, he would write the name of a movement, the name of a dancer, a length of time, and a space on the stage. Cunningham would then toss dice or dip into a grab bag to determine which dancer would do what movement for how long and where. Since 1989, he has used a computer program called LifeForms to plan his dances.

Cunningham was born in Centralia, Washington. From 1939 to 1945, he was a soloist with the Martha Graham company. In 1944, Cunningham began presenting dances in collaboration with the American composer John Cage. In 1953, Cunningham formed his own company with Cage as musical director. Cunningham has choreographed more than 150 works.

Selma Landen Odom

Cuomo, *KWOH moh,* **Mario Matthew** (1932-), gained national attention as the governor of New York. Cuomo, a Democrat, was governor from 1983 to 1994. He was the first Italian American elected to that office. A powerful orator, Cuomo established himself as a potential presidential candidate when he delivered a stirring address at the 1984 Democratic National Convention.

Cuomo was born in New York City. He received a bachelor's degree in 1953 from St. John's College (now St. John's University). In 1956, Cuomo received a law degree from St. John's. From 1956 to 1958, he served as a legal assistant to Judge



State of New York

Mario Cuomo

Adrian Burke of New York's Court of Appeals, the state's highest court. Cuomo then entered private law practice.

Cuomo first attracted public attention in 1972, when he settled a bitter housing dispute between blacks and Jews in New York City. He was appointed New York secretary of state in 1975. Cuomo was elected lieutenant governor in 1978. He was elected governor in 1982 and reelected in 1986 and 1990. In 1994, he lost a bid for a fourth term. In 1997, Cuomo's son, Andrew M. Cuomo, became secretary of housing and urban development under President Bill Clinton. Gerald Benjamin

Cupid was the god of love in Roman mythology. He was also called *Amor.* Cupid was identified with the Greek god Eros. The Romans portrayed Cupid as a son of the goddess Venus.

Cupid had both a cruel and a happy nature. His cruelty appears in his treatment of his wife, the beautiful princess Psyche. Cupid forbade Psyche ever to try to see what he looked like. He refused to be with her except at night in the dark. One night while Cupid was asleep, Psyche lit a lamp so she could look at him. Cupid awoke and fled in anger. But other myths describe Cupid as a happy lad who united lovers. See **Psyche.**

The earliest images of Cupid show him as a handsome, athletic young man. By the mid-300's B.C., he was portrayed as a chubby, naked infant with wings, holding a bow and arrows. A person shot with one of Cupid's gold-tipped arrows supposedly fell in love. His lead-tipped arrows had the opposite effect. E. N. Genovese

Cuquenán Falls, *koo kay NAHN,* also spelled *Kukenaam,* is one of the highest waterfalls in the world. The water drops 2,000 feet (610 meters). Cuquenán stands on the Cuquenán River in Venezuela near the Guyana border. See also **Waterfall** (table). Gregory Knapp

Curaçao, *KYOOR uh SOH* or *KOO rah SAH oh,* is the largest island of the Netherlands Antilles—two groups of islands in the West Indies. The Netherlands Antilles is part of the Kingdom of the Netherlands (see **Netherlands** [Government]). For location, see **West Indies** (map).

Curaçao covers 171 square miles (444 square kilometers) and has a population of about 150,000. Willemstad, the largest city on the island, is the capital of the Netherlands Antilles. A dry, nearly flat island, Curaçao has lovely beaches, warm weather the year around, and picturesque cities and towns. These features attract many tourists. Most of Curaçao's people are blacks, or have mixed black and white ancestry. Oil refining, tourism, and trade are the island's main economic activities.

American Indians were Curaçao's first inhabitants. The Netherlands gained control of the island in 1634. From the 1600's to the 1800's, the Dutch brought many black African slaves to Curaçao. Gary Brana-Shute

See also **Netherlands Antilles; Willemstad.**

Curare, *kyu RAH ree,* is the name for various substances used as arrow poison by Indians in South America. It is derived mainly from varieties of the plants *Chondodendron tomentosum* and *Strychnos toxifera.* Curare also is used by doctors to relax skeletal muscles during certain medical procedures.

South American Indians have used curare-poisoned arrows for hunting for hundreds of years. When curare enters an animal's bloodstream or body tissues, it paralyzes the skeletal muscles, including those necessary for breathing. The animal suffocates as a result.

In 1856, the French physiologist Claude Bernard showed that curare works by blocking the passage of nerve impulses to skeletal muscles. In the second half of the 1800's, some doctors used curare in treating epilepsy and tetanus. Today, the drug is used along with anesthetics to relax the patient's abdominal muscles during abdominal surgery. Doctors also use curare to relax the throat muscles during certain kinds of throat examinations. Doctors administer curare *intravenously* (into a vein) in appropriate doses. Edwin S. Munson

Curassow, *KYUR uh soh,* is the name of a group of large birds that live in forests of tropical America. The *great curassow* is found from Mexico to Ecuador. The male is mostly black with a green or blue sheen to its feathers and looks somewhat like a turkey. The female is usually brown. Like most other curassows, the great curassow has a crest of feathers on top of the head. The crest can be raised forward or lowered. In many males, the bill is brightly colored and has a raised knob on top.



WORLD BOOK illustration by John F. Eggert

A male great curassow has a brightly colored beak. Its crest of feathers on the head can be raised or lowered.

Curassows make nests of twigs and leaves in bushes or trees. The female typically lays two eggs. Curassows feed mainly on nuts and fruits from the forest floor.

Curassows can be tamed, and their flesh is good to eat. These birds are poor flyers and make easy targets for hunters. Hunting of curassows and destruction of their habitat have endangered some species.

Stuart D. Strahl

Scientific classification. Curassows belong to the family Cracidae. The scientific name for the great curassow is *Crax rubra.*

Curfew is the time of day which once brought with it evening and the end of work. The word comes from the French expression *couvre-feu* which means *cover the fire.* At curfew, a bell was rung, telling people to put out their lights, cover their fires, and get off the streets until daybreak. William the Conqueror introduced the curfew in England during the 1000's. In 1103, Henry I repealed the curfew law, but the bell continued to be rung. It is still rung in some parts of Britain.

In the United States, some communities have a curfew hour after which children may not be on the streets or in public places. The custom began long ago, but in

Omaha, Nebraska, about 1880, a curfew law was passed. Children under 15 had to be indoors after 8 p.m. unless they were with an adult or had written permission from their parents or guardians to be away from home. Many U.S. cities passed similar laws. Some communities have curfew laws for adults during wartime. Persons of an enemy nationality must often be in their homes after a certain hour in wartime. Park Dixon Goist

Curia regis, *KYOOR ee uh REE jihs,* was a term used during the early Middle Ages for the group of men who helped a king govern his country. The term means *king's court.* The curia consisted of leading barons and churchmen who advised the king on important state affairs, such as making war, declaring laws, and deciding legal cases. Less important men who ran the king's household were also part of the curia.

Starting in the 1100's, as government functions became more complex, the curia in each country developed into a number of bodies. In England, these bodies included Parliament, for legislation and taxation; the law courts; and the financial bureaus. Emily Zack Tabuteau

Curie, *KYUR ee,* is a unit of radioactivity. Its symbol is *Ci.* One curie equals 37 billion *spontaneous nuclear transformations* per second. These transformations involve the emission of particles and rays by atomic nuclei. The radioactivity of 1 gram of radium equals about 1 curie. The curie was named for French physicist Pierre Curie. The curie has been largely replaced by the *becquerel.* One becquerel equals 1 spontaneous nuclear transformation per second. John W. Poston, Sr.

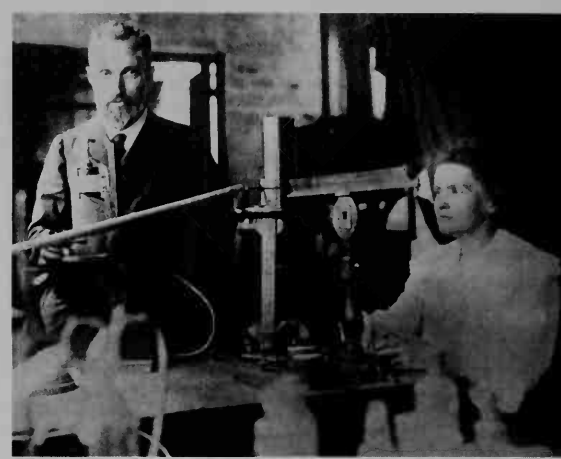
Curie, Irène Joliot-. See Joliot-Curie, Irène.

Curie, *KYOO ree,* **Marie Skłodowska,** *skwaw DAWF skah* (1867-1934), was a Polish-born French physicist who became famous for her research on radioactivity. She was the first woman awarded a Nobel Prize and the first person to win two Nobel Prizes, receiving one in physics and one in chemistry. She was also the first woman to teach at the Sorbonne, a famous university in Paris.

Curie and her husband, Pierre, also a physicist, worked together to study the radiation given off by such chemical elements as uranium and thorium. They found that the uranium ore called *pitchblende* gave off much more radiation than could be accounted for by the amount of uranium known to be in the ore. The Curies then searched for the source of the additional radiation. In 1898, they announced their discovery of two previously unknown, highly radioactive elements, which they named *polonium* and *radium.* They worked to separate tiny amounts of these elements from tons of pitchblende.

Marie theorized that radioactivity was a property linked to individual atoms rather than one that depended on the arrangement of atoms in molecules. Later, other scientists showed that polonium and radium were created by a process called *radioactive decay* or *transmutation* of the original uranium atoms. That is, the uranium atoms had changed from one element into another by giving off radiation. Previously, scientists had not known that atoms could change in any way.

The Curies' work was inspired by Antoine Henri Becquerel, a French physicist who had also conducted research on radiation. In 1903, Becquerel and the Curies won the Nobel Prize in physics. Becquerel received the award for discovering natural radioactivity and the Curies for their study of radiation. In 1911, Marie Curie won the Nobel Prize in chemistry for her discovery of the new elements and her work in isolating radium and studying its chemical properties.



Wide World

Pierre and Marie Curie became famous for their research on radioactivity. The husband-and-wife team and a co-worker isolated the radioactive element radium in 1898.

Marie Curie was born Marya Skłodowska on Nov. 7, 1867, in Warsaw, Poland, which was then ruled by Russia. Her parents were teachers. She met Pierre Curie in Paris, where she studied mathematics and science. She died on July 4, 1934, of leukemia, probably caused by years of exposure to radiation.

Douglas John Crawford-Brown

Related articles in *World Book* include:

Becquerel, Antoine Henri
Curie, Pierre
Joliot-Curie, Iréne
Polonium
Radiation (Radiation and radioactivity)
Radium
Transmutation of elements

Additional resources

Pflaum, Rosalynd. *Marie Curie and Her Daughter Irène.* Lerner, 1993.

Quinn, Susan. *Marie Curie.* Simon & Schuster, 1995.

Curie, *KYOO ree,* **Pierre,** *pyair* (1859-1906), was a French physicist known for his work in radioactivity. He shared the 1903 Nobel Prize in physics with his wife, Marie, for their study of radiation and with the French physicist Antoine Henri Becquerel for his earlier discovery of natural radioactivity. The Curies, while studying uranium, discovered two highly radioactive chemical elements, *radium* and *polonium.* A co-worker, Gustave Bémont, helped in the work with radium.

Curie was born on May 15, 1859, in Paris and studied and taught physics at the University of Paris. His early work involved research on the magnetic properties of metals. The temperature at which such properties suddenly change became known as the *Curie point.* In 1880, Curie and his brother Jacques published a paper about their discovery of the piezoelectric properties of crystals (see **Piezoelectricity**). Romualdas Sviedrys

Curium, *KYUR ee uhm,* is an artificially created radioactive element. Its atomic number is 96 and its chemical symbol is Cm.

Curium has 14 known isotopes, the most stable of which has a mass number of 247 and a half-life of 10 mil-

lion years. However, this isotope occurs in amounts too small for most experiments. Two other isotopes of the element are more readily available. One has a mass number of 244 and a half-life of 18 years. The other has a mass number of 248 and a half-life of 340,000 years. Curium melts at 1340 °C. At 20 °C, it has a density of 13.51 grams per cubic centimeter (see **Density**).

Curium was discovered in 1944 by the American scientists Glenn T. Seaborg, Ralph A. James, and Albert Ghiorso. They produced curium by bombarding plutonium with helium ions in a cyclotron. The element is named for the French chemist Marie Curie.

Richard L. Hahn

See also **Element, Chemical** (table); **Seaborg, Glenn T.**; **Transuranium element.**

Curlew, *KUR loo,* is a long-legged bird related to sandpipers and snipes. It is found from Patagonia, in the far south of South America, to the Arctic in North America. It also lives in Europe and Asia. Curlews have long, slender bills that curve downward. They are wading birds,



WORLD BOOK illustration by John Rignall, Linden Artists Ltd.

The long-billed curlew is a wading bird. It has long, bare legs, a short, rounded tail, and a long, slender bill.

but they nest on dry ground, often far from water.

The *long-billed curlew* is one of the most common. It is 2 feet (61 centimeters) long and has a short, rounded tail. Its back is pale brown and spotted with black and dark brown marks. The bird's breast is rusty-brown and is more or less streaked. It has slender, bare legs. It gets its name from its slender bill, which is about 8 inches (20 centimeters) long. It uses its bill to catch small crabs, shellfish, snails, worms, and beetles.

The *whimbrel,* or Hudsonian curlew, is a smaller member of the group. Commonly found on the eastern coast of North America, it migrates to South America in the winter. The rare *Eskimo curlew* is still smaller.

George L. Hunt, Jr.

Scientific classification. The curlew belongs to the family Scolopacidae. The long-billed curlew is *Numenius americanus.* The whimbrel is *N. phaeopus,* and the Eskimo curlew is *N. borealis.*

See also Sandpiper; Snipe.

Curley, James Michael (1874-1958), a colorful American politician, was best known as mayor of Boston. He also served as a Democratic state legislator, member of the U.S. House of Representatives, and governor of Massachusetts.

Curley served four terms as mayor (1914-1918, 1922-1926, 1930-1934, and 1946-1950). His methods and honesty were disputed, but he was popular among Boston's poor. When he was fined $30,000 in a fraud case in 1938, thousands of citizens donated money to pay the fine. In 1947, while serving as mayor, Curley went to prison for mail fraud. He served five months. President Harry S. Truman pardoned him in 1950. Curley was born in Boston.

Charles B. Forcey and Linda R. Forcey

Curling is a game played on a level sheet of ice sprinkled with water droplets. Two four-player *rinks* (teams) compete on a sheet of ice 146 feet (45 meters) long and 15 feet 7 inches (5 meters) wide. The players slide stones on the ice toward a target. Curling probably began in Scotland and the Netherlands about 400 years ago. It has become popular in more than 30 countries, including Canada and the United States. In 1998, curling became a sport in the Winter Olympic Games.

The game. Each player slides two stones toward the *house* (target), a 12-foot (3.7-meter) circle at the far end of the ice. The competitors deliver one stone at a time, alternating with their opponents. When all 16 stones have been delivered, a period called an *end* has been played. A game usually consists of 8 or 10 ends and lasts 2 to 2 $\frac{1}{2}$ hours. The stones of one rink that are closer to the house's center than any stones of the opposing rink score one point each. The opposing rink receives no points in that end.

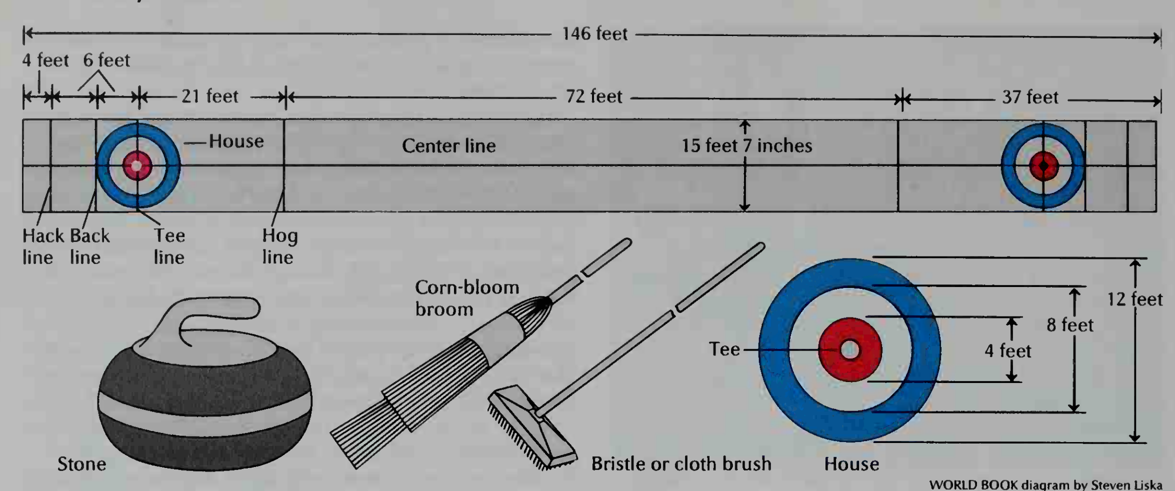
Players deliver the stones from a *hack* (foothold) 126 feet (38 meters) from the center of the house at the far end of the ice. The stones used in most regulation matches weigh 42 $\frac{1}{2}$ pounds (19.3 kilograms). Each stone has a handle on top.

To deliver the stone, the player puts one foot in the hack, then crouches with the feet together. The stone rests on the ice to the player's side. Grasping the handle, the player slides the stone straight back and rises from a crouching position. The stone may or may not come up off the ice during the backswing. Then, as the arm and



Eric Carle, Shostal

Curling players sweep the ice ahead of a sliding stone delivered by a teammate. Sweeping enables the stone to travel farther on the ice. The player on the right directs the sweepers.



WORLD BOOK diagram by Steven Liska

Curling is played in a rectangular area on a level sheet of ice. A player stands in a foothold called the *hack* and slides a granite stone down the ice toward a target called the *house*. A team scores points by placing its stones closer to the *tee*, the center of the house, than those of its opponents.

stone swing forward, the player turns the hand either in or out. This action causes the stone to turn as it is released, and it *curls* (curves) to the right or left as it slides along. The game gets its name from this action.

The rink. In club competition, a rink is composed of a *lead*, a *second*, a *third*, and the *skip* or captain. They deliver the stones in that order. The lead, who is usually the least experienced player, goes first because it is simpler to deliver with no stones on the ice. In curling tournaments, called *bonspiels*, and in national and international competition, a rink consists of four experienced players.

Before the first player delivers, the skip moves to the house at the far end of the ice. The skip indicates with a broom the spot at which the stones should be aimed. After each stone is delivered, the skip judges the line and the sweepers judge the speed of the rock. If the rock is off the intended line of delivery, the skip shouts, "Sweep." The other two players then move ahead of the sliding stone, sweeping the ice with their brooms. Sweeping alters the ice surface and lessens resistance to the stone. It can add 6 to 10 feet (1.8 to 3 meters) to a delivery. Players usually use brooms with a flat, synthetic brush head. After delivering two stones, a player joins a teammate in sweeping for the other members of the rink. Critically reviewed by the United States Curling Association

Curly-coated retriever is a dog trained to bring back game that has been shot. It gets its name from its black or liver-colored coat, which is a mass of thick, tight curls. This coat keeps the dog from getting chilled while swimming. The dog will work in cold water for a long time. It stands about 26 inches (66 centimeters) high at the shoulder and weighs from 50 to 80 pounds (23 to 36 kilograms). A curly-coated retriever is fairly easy to train and makes a good watchdog.

Critically reviewed by the Curly-Coated Retriever Club of America

See also Retriever.

Currant is a small berry that grows on a low, bushy shrub. Currants are round and smooth, and they have a sour flavor. Their colors include black, red, gold, and white. Currant plants grow best in northern regions where the weather is generally cool and humid.

There is little commercial production of currants in the United States, but the berries are grown in many home gardens. Red currants and black currants are popular in northern Europe, where they grow wild. Red currants are used for jellies, jams, wines, and pies. Black currants, which are popular in Canada as well, have a sharper flavor and are used mainly for making juice.

Currant plants serve as host plants for a disease called *white pine blister rust fungus*. This disease is harmful to white pines and similar trees. For this reason, the growing of currant plants is banned in many areas of the United States where white pine forests are of commercial value. Max E. Austin

Scientific classification. Currants belong to the saxifrage family, Saxifragaceae. The red currant and white currant are *Ribes rubrum*. The black currant is *R. nigrum;* the golden currant, *R. aureum*.

See also Gooseberry; Saxifrage.

Currency. See Money.

Current, Electric. See Electric current.

Currents, Ocean. See Ocean (How the ocean moves).



WORLD BOOK photo

The curly-coated retriever is named for its dark coat of thick, tight curls. The animal makes a good hunting dog and pet.

Curriculum, *kuh RIHK yuh luhm,* generally refers to the teaching and learning experiences provided by a school. But educators use the term in a variety of ways. Curriculum may refer to the subject matter taught or to the sequence of classes students follow. It may also describe a school's planned educational program or the educational experiences of students. Educators often distinguish between the curriculum as taught and the curriculum as learned. The term *hidden curriculum* refers to the total of experiences, attitudes, values, and behaviors a student learns in school. The hidden curriculum may or may not be intentionally taught by teachers.

Curriculum content. The United States, unlike other nations, has no standard national curriculum for public schools. However, most public schools have similar curriculums. In elementary schools, the curriculum emphasizes the basic skills of reading, writing, and arithmetic. Instruction is also provided in art, music, social studies, science, and physical education. The curriculum of junior high schools is a transition from elementary school to high school. Students study basic skills along with *disciplines,* or recognized branches of knowledge, such as social studies or humanities.

High school curriculums center around disciplines. They usually offer broad choices in courses of study called *tracks.* Tracks guide students into a sequence of classes, such as college preparatory or vocational classes. High schools also offer *electives,* which are nonrequired courses. Various activities are offered as *extracurricular,* or voluntary, beginning in junior high schools. These activities include sports teams, bands, drama, and a wide variety of clubs.

Most private and specialized schools have curriculums similar to those of public schools. However, these schools usually adopt a specialized approach to subject matter depending on the character and function of the school. For example, some private schools add a significant religious orientation to the overall curriculum. Also, many special public or private schools design curriculums to meet the needs of particular groups, such as disabled or intellectually gifted students.

Colleges offer a number of specialized curriculums. Students at community and technical colleges usually study for particular careers. Some junior colleges also have a general education curriculum. Four-year colleges offer curriculums for careers, such as nursing, engineering, or education, along with a general or liberal arts curriculum. Students following the liberal arts curriculum choose a *major,* or special area of study, such as philosophy, history, or biology. Graduate schools provide the most specialized curriculums. Some offer advanced work in a number of disciplines. Others, such as medical and law schools, focus on professional study.

Curriculum planning operates differently in the various educational institutions. School administrators and teachers usually develop the specific curriculum in public elementary and secondary schools. Their planning is influenced by such concerns as community expectations, broad national policies, and the teaching materials available. Curriculum planning is individualized at most colleges. However, departments within colleges play an important role in determining curriculums. College curriculums are also influenced by social and cultural institutions and concerns.

Curriculum changes occur as knowledge expands into new fields or as social problems force the development of new ideas and attitudes. During the late 1950's and the 1960's, for example, the exploration of space and the growth of computer technology caused a demand for more engineers, mathematicians, and scientists. This need led to the development of new content and methods in science and mathematics courses.

The 1960's and 1970's were times when traditional curriculums were challenged. For example, minority groups and others demanded changes that would reflect their particular concerns and traditions. Intense social concerns over human rights and foreign policy resulted in pressure on schools to deal with the moral and value issues involved in education. Parents and teachers also urged schools to help students cope with such issues as sexuality and drug and alcohol abuse.

In addition, many educators focused on the major social, economic, and moral aspects of curriculums. Some stressed the question of curriculum regarding the purpose of education. Others focused on the values reflected in particular curriculum practices. Still others discussed how curriculums could be designed to provide for the freedom and dignity of all people.

In the early 1980's, educators and parents began to demand more stress on achievement. This concern is reflected in the *back-to-basics* movement, which emphasizes basic reading and arithmetic skills. As a result, elementary and secondary schools have renewed their stress on traditional disciplines, such as English, history, mathematics, and science. Many schools have also become interested in *public accountability.* They emphasize *competency tests* or other forms of periodic testing to ensure specific types of learning have taken place. Colleges have also followed the back-to-basics trend by increasing requirements and reducing electives.

As schools limit what is taught, however, many educational theorists continue to challenge curriculums. Some theorists urge educators to consider the esthetic, moral, and political implications of their work.

David E. Purpel

See also **Education** (What should be taught?); **Elementary school; High school; Junior high school; Universities and colleges** (Selecting courses).

Currier and Ives was an American firm that specialized in publishing lithographs. The company flourished in the mid- and late 1800's, producing more than 7,000 images. The lithographs provided a broad view of American life, showing fashions of the time in sports, clothing, and transportation. The firm also published images of fires, shipwrecks, historical events, and portraits of celebrities. The prints were originally produced at modest cost and were widely used for interior decoration and for illustrations. Today, many of the images have become rare, highly prized, and valuable.

Nathaniel Currier (1813-1888) was born in Roxbury, Mass., and served as an apprentice in a Boston lithography shop before establishing his business in New York City. He issued his first prints in 1835.

James Merritt Ives (1824-1895), Currier's brother-in-law, served first as the bookkeeper and later as an artist and the art director for the firm. After 1857, all the prints published by the firm carried the joint name. Currier retired from the company in 1880, and Ives carried on the

business with Nathaniel's son, William Currier. Ives was born in New York City. Charles C. Eldredge

For examples of Currier and Ives lithographs, see **Baseball; Brooklyn Bridge; United States, History of.**

Curry is a blend of spices that is used to flavor a variety of fish, meat, vegetable, and grain dishes. *Curry* also refers to a stewlike dish flavored with curry spices. The curry blend is generally prepared by grinding and mixing from 2 to 20 different spices. In the United States, this ground mixture is called *curry powder.* The selection of curry seasonings varies with the dish but usually includes chili peppers, coriander, cumin, and turmeric. Some curries also include cardamom, cinnamon, cloves, fennel seeds, fenugreek seeds, ginger, and mustard seeds. Curries range in taste from hot and tangy to mild and sweet. Curry is believed to have originated in India and Pakistan. James E. Simon

Curry, Jabez Lamar Monroe (1825-1903), an American statesman and educator, worked for 60 years to make education possible for all black and white children in the South. He administered the George Peabody Fund for public education in the South after 1888, and served as agent of the Slater Fund for Negro Schools after 1890. In 1899, he became president of the Southern Educational Board.

Curry served in the U.S. House of Representatives (1857-1861), in the Confederate Congress (1861-1863 and 1864), and in the Confederate Army (1864-1865). He was president of Howard College—now Samford University—(1865-1868), and United States minister to Spain (1885-1888 and 1902). Alabama placed a statue of him in the U.S. Capitol in Washington, D.C.

Curry was born in Lincoln County, Georgia. He graduated from the University of Georgia and from Harvard Law School. Richard N. Current

Curry, John Steuart (1897-1946), an American painter, became famous for his dramatic scenes of Midwestern rural life. He admired this life for what he considered its enduring goodness and simplicity. The best known of his works include *Baptism in Kansas* (1928) and *Tornado over Kansas* (1929). Curry belonged to the art movement of the 1930's known as *regionalism.* This movement attempted to portray the American scene during the hard times of the Great Depression. He painted murals for the U.S. Department of Justice and the Department of the Interior buildings in Washington, D.C., and for the Kansas Capitol in Topeka.

Curry was born in Dunavant, Kans. He studied at the Kansas Art Institute, at the Art Institute of Chicago, and then for a year in Paris. Sarah Burns

Curtis, Charles (1860-1936), served as 31st Vice President of the United States under President Herbert Hoover. He had served in the U.S. House of Representatives from 1893 to 1907, and in the U.S. Senate from 1907 to 1913 and 1915 to 1929. Curtis was an experienced parliamentarian as a member of the Senate Rules Committee. He became majority leader of the Senate during the Administration of President Calvin Coolidge. Curtis became known for his ability to have the Senate complete its work without extra sessions.

Curtis, whose mother was part Kaw Indian, was born in North Topeka (now Topeka), Kans. As a youth, he worked as a jockey. But his interest turned to law, and he was admitted to the bar in 1881. He practiced law successfully, and became the attorney for Shawnee County. James S. Olson

See also **Vice President of the United States** (picture).

Curtis, Cyrus Hermann Kotzschmar (1850-1933), an American publisher, founded the Curtis Publishing Company in 1890. He started his first publication, *Young America,* as a 12-year-old newsboy. Later he moved to Boston and, in 1872, founded a magazine called *The People's Ledger.* Four years later, he took this publication to Philadelphia. There, Curtis started another maga-

University of Nebraska, Lincoln, F. M. Hall Collection

John Steuart Curry's paintings portray rural Midwestern life. The artist painted *The Roadmenders' Camp* in 1929.

zine, *The Tribune and Farmer,* which became the *Ladies' Home Journal* in 1883. Curtis bought *The Saturday Evening Post* in 1897 and *The Country Gentleman* in 1911.

Curtis also owned and published eight large daily newspapers. They included the *Philadelphia Public Ledger,* which he bought in 1913. Curtis purchased the *Philadelphia Press* in 1920, the *New York Post* in 1924, and the *Philadelphia Inquirer* in 1930. He organized Curtis-Martin Newspapers, Inc., a newspaper chain, in 1925. Curtis was born in Portland, Maine. He engaged in many philanthropic activities. Joseph P. McKerns

Curtiss, Glenn Hammond (1878-1930), an American inventor, made important contributions to the development of aircraft. He manufactured airplanes, and made thousands of planes during World War I (1914-1918). His Wasp held a number of records. In 1919, a Navy-Curtiss flying boat, commanded by Albert C. Read, made the first flight across the Atlantic Ocean.

Curtiss was born in Hammondsport, New York, and educated in the town's elementary schools. An interest in bicycle racing as a boy led to his flying career. From bicycles he turned to building motorcycles, one of which he raced at 137 miles (220 kilometers) per hour. In 1904, he began building engines for the first United States dirigibles, designed by Thomas Scott Baldwin. Curtiss built his airplane engine in 1907, as a member of Alexander Graham Bell's Aerial Experiment Association. In 1908, he helped design an airplane called the *June Bug.* It had a box tail and was controlled by *ailerons* (hinged flaps on the wings). Orville and Wilbur Wright had obtained a patent on a method of twisting wings to control flight. They claimed Curtiss's ailerons violated their patent. They won a court suit against Curtiss.

In 1910, Curtiss won $10,000 by flying one of his planes from Albany, New York, to New York City in 2 hours 51 minutes. He built the first planes for the United States Navy in 1911 after demonstrating that planes could land and take off from ships. Bobby H. Johnson

See also **Airplane** (picture: The *June Bug*).

Curve. See **Parabola; Circle.**

Curzon Line was the eastern boundary of Poland proposed by the Allies in 1919, after World War I. It was named for Lord George Curzon, a British diplomat. Before the war, Poland had been divided among Austria-Hungary, Germany, and Russia. The Curzon Line was to be the frontier between Russia and a new Poland. The two countries had already been at war over territory in 1919, and both rejected the plan. The Treaty of Riga in 1921 moved the border east of the Curzon Line. The line is now the boundary separating Poland from Belarus and Ukraine. William A. Jenks

Cusa, Nicholas of. See **Nicholas of Cusa.**

Cusco, *KOOS koh* (pop. 255,300), also spelled *Cuzco,* is a city in the Andes Mountains in southern Peru. It was the capital of the Inca empire in the 1400's and early 1500's. For location, see **Peru** (political map).

People had begun living in Cusco area by about 1300 B.C. However, the Inca may not have settled in Cusco until about the A.D. 1200's. The Inca empire began about 1438 under the ruler Pachacuti, who rebuilt Cusco as the empire's magnificent capital. *Cusco* means *navel* in the Quechua language of the Inca. The name refers to the city's role as the empire's capital. A network of roads linked Cusco with the rest of the empire.

Cusco appears to have been built in the shape of a *puma* (mountain lion). Religious ceremonies played a large role in Inca life, and an important temple and fortress called Sacsahuaman stood at the head of the puma. Another major temple, known as Coricancha, stood near the city's central plaza.

Only Inca nobles were allowed to live in the central part of Cusco. About 100,000 other people lived in other parts of the city. The city's main buildings—its temples and palaces—had walls of finely fitted stone blocks and roofs of thatch. Cusco also had a zoo and botanical gardens.

The Spanish explorer Francisco Pizarro conquered Cusco in 1533 and took over the inca empire. Fire swept through the city in 1536, when the Inca unsuccessfully rebelled against Spanish rule.

Today, Cusco is a trading center for local farmers. The city's industries include tanning, brewing, sugar refining, chocolate production, and the manufacture of cotton goods. Many tourists visit Cusco to see Inca and Spanish colonial architecture and to tour the ancient Inca site of Machu Picchu, which is nearby.

Alexandra M. Ulana Klymyshyn

Cuscus, *KUHS kuhs,* is a possum that lives on the northern tip of Australia and in New Guinea and nearby islands. It grows about 2 feet (61 centimeters) long, not including the tail. Cuscuses have large eyes, tiny ears, and woolly fur. The fur may be entirely brown, gray, or white, or it may be spotted or striped. The rear part of the tail is hairless and has scales.



Fleay's Fauna Reserve

The cuscus is a mammal of Australia, New Guinea, and nearby islands. The lower part of its tail is hairless and has scales.

Cuscuses move slowly and are most active at night. They live in trees and eat chiefly fruits and leaves. Cuscuses are *marsupials.* Female marsupials give birth to tiny, poorly developed offspring. Like most marsupials, the mother carries her young in a pouch on her belly until they develop more completely. Michael L. Augee

Scientific classification. Cuscuses belong to the family Phalangeridae.

See also **Possum.**

Cush. See **Kush.**

Cushing, Harvey (1869-1939), an American physician and surgeon, was one of the world's greatest brain sur-

geons. He won fame for his achievements in neurosurgery and for experimental work on the brain, nervous system, and pituitary gland. As a result of his work, neurosurgery became a respected medical subspecialty.

Cushing was born on April 8, 1869, in Cleveland. He attended Yale College and Harvard Medical School before joining the surgical staff of Johns Hopkins Hospital in 1896. In 1912, he returned to Harvard as a professor of surgery. In 1926, Cushing won a Pulitzer Prize in biography for *The Life of Sir William Osler* (1925), the life story of his friend and fellow physician. Cushing died on Oct. 7, 1939. Dale C. Smith

Custer, George Armstrong (1839-1876), was a United States Army officer who won fame as a Civil War general and an Indian fighter in the West. Custer is best known for his role in the Battle of the Little Bighorn on June 25, 1876, in the Montana Territory. In this battle, also known as "Custer's Last Stand," Sioux and Cheyenne Indians killed Custer and all the men under his direct command. The battle became famous because of disagreement over the reasons for Custer's defeat.

Early career. Custer was born on Dec. 5, 1839, in New Rumley, Ohio. As a boy, he wanted to be a soldier. He graduated from the U.S. Military Academy in 1861, ranking last in his class. But during the Civil War, which had just begun, Custer quickly gained notice as a fearless cavalry leader. In 1863, at the age of 23, he was made a brigadier general, and in 1865, a major general, both temporary ranks.

Many who served with the bold "boy general" admired his bravery and success. Many others felt that Custer was overly proud and too sure of his abilities. Some of his enemies were jealous of him and called Custer a "glory hunter." But he captured the public's attention and became a hero in the North.

After the Civil War ended in 1865, the Army dropped Custer to his regular rank of captain. He joined the Seventh Cavalry Regiment in 1866 as a lieutenant colonel. Custer won greater fame and made more enemies while fighting Indians in the southern Great Plains region and in the Dakota and Montana territories.

The 1876 campaign. In early 1876, Custer's regiment joined troops organized to force the Sioux and Cheyenne Indians onto reservations. General Alfred H. Terry commanded the expedition. In June, the main part of the force reached an area in the Montana Territory where Terry expected to find the Sioux. Terry ordered Custer's regiment to get in a position south of the Indians.

On the morning of June 25, Custer's scouts found an Indian village about 15 miles (24 kilometers) away. It lay in the valley along the Little Bighorn River. Custer expected to find about 1,000 Indian warriors. He believed his 650 soldiers could easily capture the village. However, the camp really had at least 2,000 Sioux and Cheyenne warriors. This group, whose leaders included Crazy Horse, Gall, and Sitting Bull, was probably the largest gathering of Indian warriors in Western history.



Brown Bros.

George A. Custer

The battle. Custer decided to attack immediately. He split his regiment into three groups—one under Captain Frederick W. Benteen, one under Major Marcus A. Reno, and one under himself. He sent Benteen to the south to prevent the Indians from escaping in that direction. He ordered Reno to cross the Little Bighorn and attack the village. Custer's group turned north and went downstream, probably to attack a weak point in the village.

After intense fighting in the valley, Reno's badly beaten troops retreated up the hills on the other side of the river. Benteen's group joined Reno's men there. About 4 miles (6.5 kilometers) away from this site, the Indians killed Custer and his entire unit of about 210 soldiers. The fighting may have lasted only one hour. The Indians fought Benteen and Reno's troops until June 26. Later that day, the Indians disbanded their camp and left the territory. Terry arrived with his soldiers on June 27.

The controversy. Americans found it almost impossible to believe that any group of Indians could have killed such a well-known officer and all his men. Custer's enemies accused him of disobeying Terry by attacking the Indians without waiting for the main body of soldiers. Custer's supporters charged that Reno had been a coward, and could have rescued Custer if he had not retreated. Others blamed Terry and his aides for not knowing the size of the Indian force. Historians still argue about the reasons for Custer's defeat, but no one really knows. Brian W. Dippie

See also Crazy Horse; Gall; Indian wars (The Sioux wars); Reno, Marcus A.; Sitting Bull.

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Custis, Martha. See Washington, Martha Custis.

Custom is a practice or a way of doing things that has been handed down from one generation to the next. Customs are part of the culture shared by members of a social group. Many customs begin because people like to know what to expect in social situations. Like all cultural traits, customs are a form of learned behavior and differ among different peoples. For example, eating is a requirement for all people, but table manners and customs of food preparation vary among social groups.

Practices that change frequently are called *fashions.* They include social dances, styles of dress, and slang expressions. Fashions that quickly come and go are called *fads.* A fashion may become a custom through long usage. For example, eating with a fork was a fashion in Europe during the 1500's, but it is now a custom throughout the Western world.

Customs last partly because people often find it easier

to conform than to face the disapproval of their social group. Such disapproval may range from mild ridicule to severe punishment. Many customs produce only mild reactions when broken. Such customs include many wedding and funeral traditions and rules of etiquette. A person who departs from such customs may encounter surprise, annoyance, or scorn. Important customs that reflect a society's ideas of right and wrong are called *mores*. Examples include the reaction of people to murder or cannibalism, which produce anger and shock.

In isolated, nonindustrial communities, most customs remain unchanged from generation to generation. The majority of people in such societies believe the old ways are best—and what was good for the parents is good for the children. In modern industrial societies, however, customs change more easily. A number of factors, including new inventions and contact with other cultures, may lead to such changes. Hanan C. Selvin

Related articles. See the country articles in which customs are discussed, such as **India** (Way of life). See also:

Clothing (Clothing around the world)
Etiquette
Fashion
Feasts and festivals
Folklore (Superstitions and customs)
Food
Funeral customs
Holiday
Mores
Rite of passage
Taboo

Customs are duties paid to a nation's government on items that people bring in from another country. Each nation has its own regulations regarding the quantity and kinds of articles that may be imported.

Customs inspectors examine the baggage of all travelers returning to a country. All articles acquired abroad must be *declared*—that is, they must be identified and their value given to an inspector. If a person fails to declare an article or understates its value, the article may be taken away and the individual may be fined.

In the United States, articles totaling up to $400 are *exempt* (free from any duty) if they meet certain regulations. For example, the articles must be for personal use, and the person's trip must have lasted at least 48 hours. Also, the articles cannot be prohibited or restricted by federal regulations. The $400 exemption can be claimed by a person once every 30 days. The 48-hour rule does not apply to trips to Mexico or the Virgin Islands.

If a traveler cannot claim the $400 exemption because of the 48-hour or 30-day restriction, he or she may claim a $25 exemption. However, a person must pay duties on all articles if their total value exceeds $25. Duty rates depend on the type, value, and quantity of the articles.

Prohibited items include illegal narcotics and dangerous drugs, obscene publications, and switchblade knives. Certain items, such as firearms, fruit, meat, and vegetables, are either prohibited or require an import permit. Federal laws allow the importation of up to 1 liter (1.06 quarts) of alcoholic beverages and up to 200 cigarettes and 100 cigars for personal use.

Critically reviewed by the United States Customs Service

See also **Bonded warehouse; Customs Service, U.S.; Smuggling.**

Customs Court, United States. See Court of International Trade, United States.

Customs Service, United States, is an agency of the United States government that helps protect the nation and collects taxes on imported merchandise. These taxes, called *tariffs,* include customs duties, excise taxes, and penalties. The agency collects about $20 billion a year, more than any other federal agency except the Internal Revenue Service, which collects income taxes.

The Customs Service processes goods, people, and vehicles entering or leaving the United States. For example, customs inspectors examine the baggage of travelers returning to the country. The agency works to prevent smuggling and to enforce many other federal laws, including those governing environmental protection and motor vehicle safety. It also works to protect U.S. business and labor by enforcing copyright, patent, and trademark regulations.

The service administers seven customs regions in the United States, Puerto Rico, and the Virgin Islands. These regions are divided into 44 districts with about 300 *ports of entry*. Ports of entry are cities with customs facilities where goods may enter the country legally. The commissioner of customs directs the agency.

The First Congress established the service in 1789. The service's headquarters are in Washington, D.C.

Critically reviewed by the United States Customs Service

See also **Customs.**

Customs union is an association of two or more countries to encourage trade. The countries making such an arrangement agree to eliminate duties and other restrictive regulations on trade among them. Members of the union apply a single set of tariffs to all countries outside the union. A *free trade area* is like a customs union, except that the members of a free trade area may apply separate tariffs against nonmembers.

The best-known customs unions have included the Zollverein, Benelux, and the European Community (EC). The Zollverein was formed by German states in the 1830's. These states became the German nation in 1871. Belgium, the Netherlands, and Luxembourg established Benelux in the 1940's. In the 1950's, Belgium, France, Italy, Luxembourg, the Netherlands, and West Germany set up what became the European Community, which was incorporated into the European Union in 1993. The United Kingdom, Denmark, and Ireland joined the EC in 1973. Greece joined in 1981; Portugal and Spain in 1986; and Austria, Finland, and Sweden in 1995.

Robert M. Stern

See also **Benelux; European Free Trade Association; European Union.**

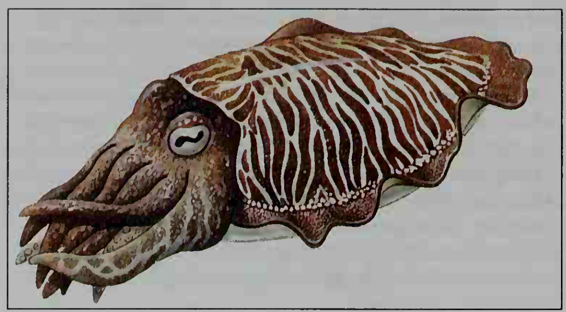
Cutch. See Catechu.

Cutlassfish is a type of saltwater fish with a long, slender body that tapers to a hairlike tail. Cutlassfish live in all warm seas and are abundant in the Caribbean and the Gulf of Mexico. These fish have a large mouth with four large barbed fangs in the upper jaw and two in the lower jaw. Most cutlassfish measure about $2\frac{1}{2}$ feet (75 centimeters) long, but some grow as long as 5 feet (150 centimeters). Cutlassfish living off the coast of Japan lay their eggs in fairly shallow waters. The fish are caught for food in some areas. Tomio Iwamoto

Scientific classification. Cutlassfish belong to the cutlassfish family, Trichiuridae.

Cutting. See Plant (Vegetative propagation).

Cuttlefish is a soft, boneless animal related to the squid. It is found in most seas except those surrounding the Americas. It usually lives on the sea bottom near the shore. The cuttlefish ranges in size from about 3 inches (8 centimeters) to about 5 feet (1.5 meters) long. Its oval



WORLD BOOK illustration by Colin Newman, Linden Artists Ltd.

The cuttlefish has a broad head with two large eyes. It has eight short arms and two long tentacles surrounding the mouth.

body is commonly brown with crossbands and purple spots. It is brilliantly metallic in the sunlight and often changes color. A frilled fin surrounds the fish's body.

The cuttlefish has eight short arms and two long armlike tentacles that surround the mouth. Both the arms and the tentacles have rows of hard and rough suckers. The tentacles can be pulled into pockets behind the eyes. The cuttlefish uses its arms to attach itself to objects. The cuttlefish can use its tentacles and arms to capture prey such as prawns, crabs, and fish.

The cuttlefish has an internal shell called the *cuttlebone.* The broad cuttlebone is porous and chalky. It is often used in making toothpaste.

The cuttlefish moves by using its fin or by forcing water from a funnellike organ on its backside. To hide from enemies, the cuttlefish can bury itself in the sand, camouflage itself, or darken the water by pouring out an inky substance. This substance contains the brown *pigment* (coloring matter) called sepia. Ink made from sepia was widely used in ancient times. Brian Hartwick

Scientific classification. The common cuttlefish is in the cuttlefish family, Sepiidae. It is classified as *Sepia officinalis.*

See also **Mollusk; Nautilus; Octopus; Squid.**

Cutworm is the caterpillar of certain dull-colored, night-flying moths. Cutworms have a smooth skin and vary in color from light gray to black. Some are striped or spotted. Cutworms are quite destructive. Groups of cutworms have been known to destroy entire fields of young wheat, corn, or garden vegetables overnight. Cutworms also may cause much damage to tobacco, cotton, and various kinds of fruit trees. From one to four generations of cutworms may grow each year. Some spend the winter as pupae, others as larvae. Solitary cutworms feed beneath the soil. Climbing cutworms crawl up the plants at night to feed. Gardeners kill cutworms with poisoned baits and sprays. John R. Meyer

Scientific classification. Cutworms are in the owlet moth family, Noctuidae.

See **Moth.**

Cuvier, *KYOO vee AY* or *koov YAY,* **Baron** (1769-1832), was a French naturalist who studied *comparative anatomy,* a branch of zoology that compares the differences and similarities in the body structure of different animals. Cuvier included investigations of the remains of prehistoric animals in his comparisons. He wrote *The Animal Kingdom* (1817), which became an authoritative reference on the classification of animals.

Cuvier began his work by dissecting marine *invertebrates* (animals without backbones). He later studied many large land mammals, including the rhinoceros and the elephant. Cuvier proposed the theory of *geological catastrophe* to explain why many fossil animals no longer exist. This theory held that great volcanic upheavals and similar catastrophes destroyed many forms of life. Cuvier believed that the distinctive anatomical characters of various animal groups was proof that they had not evolved from the same ancestor. Cuvier also believed that species did not change over time.

Georges Léopold Chrétien Frédéric Dagobert Cuvier was born on Aug. 23, 1769, in Montbéliard, France. He taught at the College of France. He helped found some of the French provincial universities. Cuvier died on May 13, 1832. G. J. Kenagy

See also **Biology** (The origins of scientific classification).

Cuyahoga Valley National Park, *KY uh HOH guh, kuh HOH guh,* or *kuh HAW guh,* centers on the valley formed by the Cuyahoga River between Cleveland and Akron in northeastern Ohio. The park also includes forests, meadows, gorges, and wetlands. For area, see **National Park System** (table: National parks).

The park has numerous species of trees and wildflowers, and its abundant wildlife includes beavers, coyotes, and white-tailed deer. Visitors may follow the Towpath Trail along the historic Ohio & Erie Canal or take a scenic train ride through the valley. Other attractions include Tinkers Creek Gorge, Brandywine Falls, and Hale Farm & Village. The Cuyahoga Valley National Recreation Area was established in 1974. It became a national park in 2000. Critically reviewed by Cuyahoga Valley National Park

Cuzco. See **Cusco.**

Cyanide, *SY uh nyd,* is the name given to metal salts containing the CN group (a carbon atom linked to a nitrogen atom). Sodium cyanide (NaCN) and potassium cyanide (KCN) are important industrial chemicals. Both are used in the cyanide process of separating gold and silver from their ores, and in the hardening of steel. Both forms also are very poisonous if swallowed or absorbed through injured skin. Strong acids react with metal cyanides to make hydrogen cyanide (HCN), a deadly poison gas. Organic cyanides are *nitriles.* Acrylonitrile, important in the manufacture of fabrics, plastics, and synthetic rubber, is made from cyanide. Chemists use cyanide in solutions for electroplating and in the production of drugs and other chemicals. Marianna A. Busch

See also **Gas chamber; Prussic acid.**

Cyanite. See **Kyanite.**

Cyanobacteria. See **Algae; Prokaryote.**

Cyanosis, *SY uh NOH sihs,* is a medical condition involving a bluish tint of the skin and the mucous membranes. Cyanosis results if the blood flowing through vessels in the skin and mucous membranes contains too much *reduced hemoglobin*—that is, hemoglobin not combined with oxygen. Hemoglobin is the compound in red blood cells that carries oxygen. When combined with oxygen, hemoglobin makes blood bright red. Blood containing large amounts of reduced hemoglobin appears bluish when seen through the skin and mucous membranes.

Cyanosis may occur among people who live at high altitudes, where air pressure is low and less than the normal amount of oxygen is available. It may result from

abnormalities in hemoglobin or heart and lung ailments that prevent blood from combining properly with oxygen. For example, *blue babies* have cyanosis because a heart defect prevents some blood from entering their lungs to receive oxygen (see **Blue baby**). Cyanosis also can occur when blood circulates poorly after a person goes into shock or suffers heart failure.

Cyanosis resulting from too little oxygen may be treated by improving the patient's respiration or by using an oxygen tent or mask. Physicians treat cyanosis caused by poor circulation by increasing the rate of the blood flow. G. David Roodman

Cybernetics, *SY buhr NEHT ihks,* is the study of control and communication in machines and animals. Norbert Wiener, an American mathematician, introduced the term *cybernetics* in his book of the same name, first published in the United States in 1948.

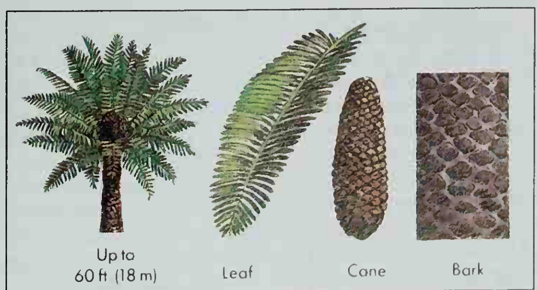
Wiener's book described the similarities in the functioning of human beings and machines. Wiener and others had observed that both people and machines were purposeful and orderly, sought stability, and used information. One of their most important shared characteristics, according to Wiener, was the use of *feedback.* Feedback involves the circling back of information to a control device to adjust behavior. For example, when the body temperature of a human being is too high or too low, this information is *fed back* to the brain. The brain then acts to correct the temperature. A household thermostat uses feedback when it corrects the operation of a furnace to maintain a set temperature.

Cybernetics has prompted attempts to build machines that imitate human behavior, including decision-making and analysis of data. Because such machines accomplish more than the simple mechanization of work, some theorists argue that cybernetics has started a second industrial revolution.

Since the 1940's, the ideas of cybernetics have influenced such fields as biochemistry, computer science, and psychology. Today, many specialized terms have replaced the word *cybernetics.* In business fields, the term is no longer used. David McComb

See also **Wiener, Norbert.**

Cycad, *SY kad,* is a large subtropical and tropical seed plant. It is related to *conifers* (cone-bearing trees), such as the pine and spruce, but looks like a palm or fern. Some cycads have unbranched, erect stems that may be 60 feet (18 meters) high. Others have a partially underground stem, called a *tuber,* that resembles a potato. Some species reach ages of nearly 1,000 years.



The cycad plant bears its seeds in cones.

The cycad's leathery, fernlike leaves grow in a circle at the end of the stem. New leaves emerge every year and live several years. The cycad has a *strobilus* (large cone) that contains seeds. The cone grows erect in the center of the circle of leaves. When the seeds mature, part of the strobilus shrivels, allowing the seeds to drop.

Scientists have found fossils which show that cycads were common during prehistoric times. The cycads are the most primitive seed plants, but not necessarily the most ancient. They grow in only a few small areas. One kind of cycad, called *Zamia,* is common in tropical America. Thomas B. Croat

Scientific classification. Cycads make up the order Cycadales.

See also **Conifer; Gymnosperm; Seed.**

Cyclamen, *SY kluh muhn* or *SIHK luh mehn,* is the name of a group of attractive plants that grow wild in the Mediterranean region of Europe. Cyclamens are cultivated outdoors in areas where the climate permits or indoors in pots. The leaves are heart- or bean-shaped and have long *petioles* (leafstalks). The flowers are white, rose, or purple and have no fragrance. They measure up to $2\frac{1}{2}$ inches (6.4 centimeters) long.

Cyclamens are cultivated from seed and grow best at temperatures from 50 to 60 °F (10 to 16 °C) in rich, moist soil. Some species flower in the spring, and others bloom in the summer or autumn. Cyclamen plants that are cultivated indoors or in greenhouses may flower in the winter. See also **Primrose.** Melinda F. Denton

Scientific classification. Cyclamens belong to the primrose family, Primulaceae. They make up the genus *Cyclamen.*

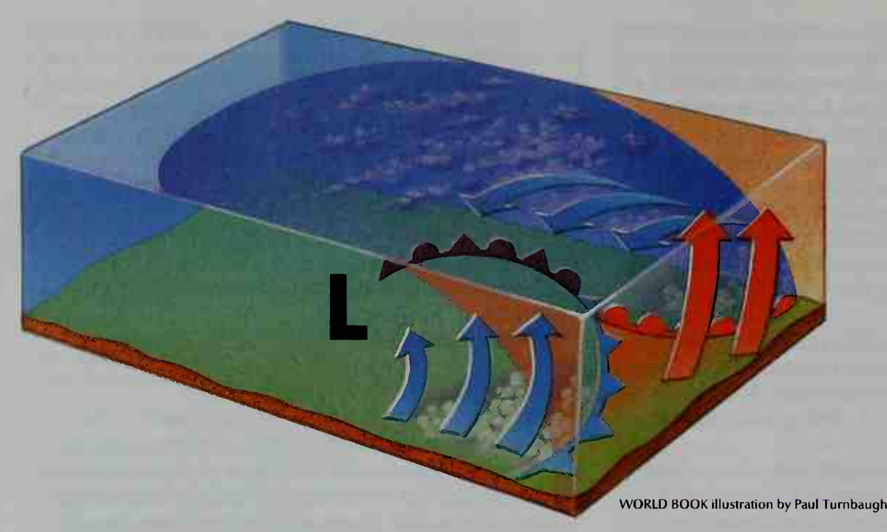
Cycling. See **Bicycle racing.**

Cyclone is often used to mean a violent, swirling windstorm. To scientists, however, the term *cyclone* more commonly refers to the weather system in which this type of storm occurs. In this sense, a cyclone is any weather system except a tornado in which the air pressure at Earth's surface is relatively low.

A cyclone—in the sense of a low-pressure system—acts as a "weather maker" in the *middle latitudes.* These are zones that extend from the Tropic of Cancer to the Arctic Circle and from the Tropic of Capricorn to the Antarctic Circle. A cyclone may be accompanied by strong winds and widespread areas of cloudiness and precipitation. A single cyclone can affect the weather over a third of a continent or more.

Viewed from above, the surface winds of a cyclone in the Northern Hemisphere blow counterclockwise and inward. In the Southern Hemisphere, the winds blow clockwise and inward. The winds bring together contrasting masses of air in the middle latitudes and in the high latitudes north of the Arctic Circle and south of the Antarctic Circle. Air masses may differ in temperature, humidity, or both. Where contrasting air masses meet, warm and cold fronts develop and spiral outward from the cyclone center. Warm air rises along the fronts, often producing cloudiness and rain or snow. *Prevailing westerlies* (winds from the west) steer a middle-latitude cyclone to the east and northeast.

A different kind of cyclone develops in or near the *tropics,* the regions between the equator and the Tropics of Cancer and Capricorn. A tropical cyclone has about one-third the diameter of a middle-latitude cyclone; it forms in warm, humid air over very warm



A cyclonic weather system in the middle latitudes extends from an area of low air pressure, indicated by an *L* in this diagram. In the Northern Hemisphere, winds blow counterclockwise, as shown. In the Southern Hemisphere, they blow clockwise. Red arrows show warm air blowing along a warm front (red line). Blue arrows show cold air blowing along a cold front (blue line) and an *occluded front* (purple line), where warm and cold fronts merge.

WORLD BOOK illustration by Paul Turnbaugh

ocean water; and it has no fronts. Prevailing winds steer it to the west.

The most intense tropical cyclone is a storm with extremely low air pressure at its center, surface winds blowing at speeds greater than 74 miles (119 kilometers) per hour, and heavy rains. Such a storm is called a *hurricane* when it occurs over the North Atlantic Ocean, the Caribbean Sea, the Gulf of Mexico, or the Northeast Pacific Ocean. It is known as a *typhoon* in the Northwest Pacific Ocean. Near Australia and in the Indian Ocean, it is referred to as a *tropical cyclone*. Joseph M. Moran

See also **Hurricane; Storm; Tornado; Weather; Wind.**

Cyclonite. See **RDX.**

Cyclopedia. See **Encyclopedia.**

Cyclops, *SY klahps,* in Greek mythology was any member of a race of giants with one eye in the middle of the forehead. Three Cyclopes—Arges, Brontes, and Steropes—were sons of the sky god Uranus and the earth goddess Gaea. The three made the thunderbolts carried by Zeus, king of the gods.

The best known of the Cyclopes was Polyphemus. The epic poem the *Odyssey* describes how the Greek hero Odysseus and his men sailed to an island inhabited by Polyphemus. The Cyclops imprisoned the Greeks and ate six of them. After Odysseus made Polyphemus drunk, he and his surviving men put out the giant's eye with a burning stake and escaped. Polyphemus prayed to his father, the sea god Poseidon, to punish Odysseus. As a result, Odysseus suffered many hardships and delays before reaching his home. Another story tells how Polyphemus killed the Sicilian youth Acis, his rival for the love of the sea nymph Galatea. Robert J. Lenardon

Cyclosporine, *sy kloh SPAWR een,* is a drug that fights rejection of transplanted body tissues and organs. The drug is widely used in operations in which the heart, liver, pancreas, bone marrow, a kidney, or a lung of one person is transferred to another person. It is produced from cultures of the fungus *Tolypocladium inflatum.* Jean Borel, a Swiss immunologist, discovered the medicinal properties of cyclosporine in 1972. Cyclosporine was first used in transplant operations in 1981. Its use has reduced the number of complications and deaths resulting from transplants.

Cyclosporine prevents a person's immune system from attacking a transplanted organ as if it were a dangerous invader. The drug blocks production of a type of white blood cells called *T-helper cells* that recognize and attack foreign invaders. T-helper cells identify transplanted tissues as foreign and attack them. This attack causes the body to reject the transplant. In addition to its use before and after transplant operations, cyclosporine helps treat certain diseases in which T-helper cells attack a person's own tissues.

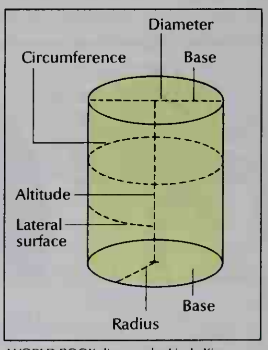
Patients may take cyclosporine orally in capsules or as a liquid. The drug also may be injected into the bloodstream. Cyclosporine may produce side effects. The most serious include high blood pressure, reduced kidney function, liver damage, and abnormal growth of hair. To reduce its toxic effects, cyclosporine is often given in combination with other drugs. Bruce A. Reitz

Cyclotron. See **Particle accelerator.**

Cygnet. See **Swan.**

Cylinder, in geometry, is a solid figure with two identical bases that lie on parallel planes. Each base is bounded by a curved edge, called the *directrix.* The *lateral surface* (side) of a cylinder consists of parallel lines that join corresponding points on each base. When the directrixes of a cylinder are circles, the figure is called a *circular cylinder.* A *right circular cylinder* is a circular cylinder with a lateral surface that is perpendicular to the bases. Circular cylinders with a lateral surface not perpendicular to the bases are called *oblique circular cylinders.* A cylinder whose directrixes are ellipses is called a *cylindroid.*

A cylinder's *height (h)* is the perpendicular distance between the planes of the bases. The volume (V) of a cylinder can be calculated by multiplying the height by the area (B) enclosed by either of the two bases: $V=Bh$. If the bases of the cylinder are circles, then $B=\pi r^2$, where r stands for the radius of either of the circles. The formula for the



WORLD BOOK diagram by Linda Kinnaman

Parts of a cylinder

volume can then be written: $V = \pi r^2 h$. An approximate value for π (pi) is 3.1416.

The area of the lateral surface in a right circular cylinder is equal to the circumference of the base times the height. It can be found using the formula $L = \pi rh$. In the formula, L stands for the lateral surface area. The *total surface area (A)* of a right circular cylinder, therefore, can be calculated by adding together the lateral surface area and the areas of the two bases: $A = 2\pi rh + 2\pi r^2$ or $2\pi r(h + r)$. John K. Beem

Cymbal is a brass percussion instrument shaped like a broad-brimmed hat. The center of a cymbal resembles the crown of a hat. A musician may hold the cymbal by a leather handle attached to the center or hang the instrument on a stand. A player can produce tones that vary in quality by striking two cymbals together or by striking one cymbal with a mallet. The mallet may be made of metal or wood, and some mallets are covered with felt or yarn.

Cymbals are made in many sizes. Most musicians prefer cymbals that measure from 12 to 22 inches (30 to 56 centimeters) in diameter. Cymbals vary in thickness as well as diameter, and no two sound exactly alike. See **Music** (picture: Percussion instruments).

Cymballike objects were found in the ruins of the Indus Valley civilization, which arose in what are now Pakistan and northwestern India about 2500 B.C. The cymbal was first used by an orchestra in an opera in 1680 in Hamburg, Germany. The Zildjian Company in the United States manufactures the most widely used cymbals in the world. The company has been making cymbals by a secret method since 1623. John H. Beck

Cynic philosophy, *SIHN ihk,* was established in the 300's B.C. by Antisthenes, a disciple of Socrates. He took as his starting point the doctrine of his great teacher that virtue rather than pleasure is the chief end of life, and constitutes true happiness. He argued that the wise person is the one who looks with contempt on all the ordinary pleasures of life, and lives without regard for riches or honors. Continued happiness, he declared, is not possible if a person has wants and desires which may not be satisfied. A person is bound by no obligations to society, state, or family, because these things give rise to desires that cannot be satisfied.

Among the enthusiastic followers of Antisthenes was Diogenes, who carried the principles of the Cynics to an extreme. It is said that he lived on the coarsest bread and slept at night in a tub. Zeno of Citium, a Cynic of the late 300's and early 200's B.C., founded Stoic philosophy (see **Stoic philosophy**).

Some authorities say that the name *cynic* refers to *Cynosarges,* the name of the building in Athens where the Cynics first met. Others say that the name comes from the Greek word for dog, and refers to the rude manners of the Cynics. In ordinary speech, a person who sneers at the idea that goodness exists in human nature is often called a *cynic.* S. Marc Cohen

See also **Diogenes; Zeno of Citium.**

Cypress, *SY pruhs,* is any one of a group of evergreen trees and shrubs that grow in North America, Europe, and Asia. There are approximately 13 species of cypresses. Six of these species grow naturally in the Southwestern United States. The *baldcypress* is not a true cypress but is related to the sequoia.

Cypresses adapt readily to warm climates, and gardeners often use them as ornamentals. The trees have small, scalelike leaves that grow in dense fan-shaped sprays. Their globe-shaped cones are covered by woody scales that look like small shields. The wood is light brown, durable, and has a strong cedarlike odor.

The *Monterey cypress* is one of the most picturesque trees in North America. It is named for the Monterey Peninsula of California, its native region. Its trunk is rarely more than 20 inches (50 centimeters) in diameter. The tree has long, strong, massive limbs that spread and grow in unusual shapes. It often grows near the ocean shore, where its branches are gnarled and bent by strong ocean winds. The Monterey cypress is a favorite subject for artists. Douglas G. Sprugel

See also **Baldcypress; Cedar; Conifer; Tree** (Familiar broadleaf and needleleaf trees [picture]).

Scientific classification. Cypresses belong to the cypress family, Cupressaceae. The scientific name for the Monterey cypress is *Cupressus macrocarpa.*

Cyprus, *SY pruhs,* is an island in the northeastern corner of the Mediterranean Sea. It lies about 40 miles (65 kilometers) south of Turkey, 60 miles (95 kilometers) west of Syria, and 470 miles (760 kilometers) southeast of Greece. Geographically, Cyprus is part of Asia.

Cyprus is divided politically and culturally into two sections: the Republic of Cyprus and the Turkish Republic of Northern Cyprus (TRNC). Cypriots of Greek origin control the Republic of Cyprus, which is in the southern part of the island. People of Turkish ancestry control the Turkish Republic of Northern Cyprus. The government of the Greek Cypriot section is recognized by all countries except Turkey as the legal government of the entire island of Cyprus. Only Turkey recognizes the northern section as an independent nation. Nicosia (called Lefkosa by Turkish Cypriots) is the capital of both sections.

Cyprus lies on major trade routes between Europe and Asia, and a number of peoples have controlled the island through the centuries. They include Egyptians, Assyrians, Persians, Macedonians, Romans, Byzantines, and Venetians. Cyprus became part of the Ottoman Empire in 1571. In 1878, it came under British rule. Cyprus became independent on Aug. 16, 1960.

The Constitution of Cyprus originally provided for shared governmental powers between the island's Greek and Turkish Cypriot communities. But deep divisions and mistrust between the two groups led to violent clashes. In July 1974, Turkish troops landed in northern Cyprus in response to what the Turkish government saw as a Greek attempt to unite Cyprus with Greece. After widespread fighting, a cease-fire was declared in August, and the island became divided into separate Greek and Turkish Cypriot sections.

Government. A president, elected by the people for a five-year term, heads the government of the Republic of Cyprus. The president appoints members of the Council of Ministers. A one-house legislature called the House of Representatives makes the republic's laws. The Supreme Court is the highest court.

The Constitution of the Turkish Republic of Northern Cyprus provides for a president to be elected for a five-year term. The president appoints a prime minister from the members of the Legislative Assembly. The Supreme Court is the highest court of the TRNC.

Cyprus







WORLD BOOK maps

People. Greek Cypriots make up more than three-fourths of the population of the island. Turkish Cypriots make up most of the rest. The majority of the Greek Cypriots belong to the Orthodox Church of Cyprus, one of the Eastern Orthodox Churches. Most Turkish Cypriots are Muslims. The center of society for both Greek and Turkish Cypriots is the family. Both communities place great value on family honor and loyalty.

In cities, most homes and apartments are constructed of cement blocks, concrete bricks, and stone. In villages, the building materials sometimes include sun-dried mud bricks. Most homes in urban areas have flat concrete roofs or slanted tile roofs. In rural areas, some houses have flat mud roofs.

People in most cities of Cyprus wear clothing similar to that worn in Europe and North America. In rural areas, some men wear the traditional attire of richly decorated vests and baggy black trousers called *brakas* in Greek and *salvar* in Turkish. Some Greek women in rural areas wear short blouses and long skirts called *sarkas.*

Greek and Turkish Cypriots enjoy similar kinds of food. Many dishes are prepared with olive oil and contain meat mixed with vegetables. Favorite dishes include *souvlaki* (meat cooked on a long rod, usually with tomatoes and onions), *stiva* (beef stew), and *tava* (lamb stew). Popular beverages include beer, brandy, soft drinks, and wine. Cypriots also like to drink an anise-flavored liquor called *ouzo* in Greek and *raki* in Turkish.

Greek is the primary language of the south, and Turkish the language of the north. But English is widely spoken by both communities.

Most adult Cypriots can read and write. Elementary and secondary education throughout the island is free. In the south, children from 6 to 15 years old are required to attend school. In the north, children from 7 to 15 years of age must attend school. The University of Cyprus, in Nicosia, is the only university in the Greek section of the island. The Eastern Mediterranean University in Famagusta is the largest university in the north.

Cypriots enjoy sports, especially soccer and swimming. They also relax by playing cards and backgammon and by taking family picnics to the beaches or mountains. Coffee houses are popular social gathering places for people in both communities.

Land and climate. Two mountain systems dominate the landscape of Cyprus. The rugged Kyrenia range stretches along the northern coast. Parts of the Troodos Massif, in the southwest, are thickly forested. Mount Olympus, the range's highest peak, rises 6,403 feet (1,952 meters) above sea level. Between the two systems lies the Mesaoria Plain, the island's chief agricultural region.

Cyprus has a pleasant, sunny climate. Snow falls high in the Troodos Massif early in the year. Winters are mild in the Mesaoria Plain, but temperatures may rise above 100 °F (38 °C) in summer. Rainfall on the plain averages from 12 to 16 inches (30 to 41 centimeters) a year. Parts of the Troodos receive over 40 inches (100 centimeters).

Economy. The Greek section of Cyprus has a higher standard of living and a stronger economy than does the

Facts in brief

Capital: Nicosia.

Official languages: Greek and Turkish (Republic of Cyprus); Turkish (Turkish Republic of Northern Cyprus).

Area: 3,572 mi² (9,251 km²). *Greatest distances*—east-west, 138 mi (223 km); north-south, 60 mi (97 km).

Elevation: *Highest*—Mount Olympus, 6,403 ft (1,952 m) above sea level. *Lowest*—sea level.

Population: *Estimated 2002 population*—798,000; density, 223 per mi² (86 per km²); distribution, 64 percent urban, 36 percent rural. *1992 census*—602,025. Census population is for Republic of Cyprus only.

Chief products: *Agriculture*—barley, grapefruit, grapes, lemons, olives, oranges, potatoes, wheat. *Manufacturing*—cement, cigarettes, clothing, shoes, textiles, wines.

Money: *Basic unit*—Cyprus pound (Republic of Cyprus); Turkish lira (Turkish Republic of Northern Cyprus).



Ciganovic, FPG

Nicosia is the capital and largest city of Cyprus. The city's skyline shows the Turkish influence on its architecture. The Kyrenia Mountains rise in the background.

Turkish section. The United Kingdom is the chief trading partner of the Republic of Cyprus. No country except Turkey recognizes the TRNC as a separate nation, and few countries are willing to invest in it. Turkey is the main trading partner of the TRNC.

The economy of both sections of Cyprus depends on agriculture, light manufacturing, and tourism. Chief farm products include barley, grapefruit, grapes, lemons, olives, oranges, potatoes, and wheat. Factories produce cement, cigarettes, clothing, furniture, plastic, shoes, textiles, and wine. Tourists visit the island's mountain resorts, glistening beaches, and archaeological sites.

Cyprus has few natural resources. Copper was produced in large quantities in the past, but resources of this mineral are dwindling. Cyprus's other natural resources include clay and gypsum.

International airports at Larnaca and Paphos serve the Greek section. Larnaca and Limassol are the chief ports. The Turkish area has international airports at Ercan and Lefkoniko. The main ports are Kyrenia and Famagusta.

History. People have lived on Cyprus since about the 6000's B.C. Greek settlers arrived on the island about the 1100's B.C. Before the time of Christ, the Phoenicians, Assyrians, Egyptians, Persians, Macedonians, and Romans conquered Cyprus. Saint Paul and Saint Barnabas brought Christianity to the island shortly before A.D. 50.

When the Roman Empire split into two parts in A.D. 395, Cyprus became part of the East Roman, or Byzantine, Empire. From about the mid-600's to the late 900's, Muslim Arabs conducted a series of raids on the island. In 1191, King Richard I of England seized Cyprus from the Byzantine Empire and sold it to a Christian religious order called the Knights Templars. The following year, the Templars transferred control of the island to Guy de Lusignan, a French nobleman.

In 1489, Venice took control of Cyprus. During 1570 and 1571, the Ottoman Empire conquered the island. In 1878, Britain and the Ottoman Empire signed an agreement that allowed Britain to administer Cyprus. Britain annexed the island in 1914, when the Ottomans joined the opposing side during World War I. Cyprus became a British crown colony in 1925.

The British introduced educational, administrative, social, and economic reforms. But Britain also encouraged divisions between the Greek and Turkish Cypriots as a way of keeping the groups from uniting against British rule. Eventually, Greek nationalists called for *enosis* (union with Greece), and Turkish Cypriots demanded partition of the island into Greek and Turkish zones.

In the 1950's, Greek Cypriots, under the leadership of Archbishop Makarios III, started an active campaign for enosis. A Greek Cypriot secret organization called EOKA began guerrilla attacks on the British—and later against the Turks. Britain declared a state of emergency on the island in 1955 and exiled Makarios in 1956. The Cyprus crisis contributed to deterioration of relations between Greece and Turkey, and the two Cypriot communities.

In 1959, Greece, Turkey, the United Kingdom, and leaders of the two Cypriot communities signed the Zurich-London Agreements. The agreements granted Cyprus independence on Aug. 16, 1960. They also stated that Greece, Turkey, and Britain could act together or separately to prevent either enosis or partition of the island. Britain was given two military bases on the island.

The 1960 Constitution provided for a Greek president and a Turkish vice president, each elected by their respective communities. Makarios became president. In 1963, he suggested 13 proposals for amending the Constitution, arguing that they would result in better administration of the country. Turkey and the Turkish Cypriot leaders opposed the changes, arguing that the changes would eliminate many of the Turkish Cypriots' rights and safeguards. Fighting broke out between Greek and Turkish Cypriots. The violence ended Turkish Cypriot participation in the Cyprus government in 1963. In 1964, the United Nations (UN) sent a peacekeeping force to Cyprus. In 1967, another clash between the two groups caused a new crisis. The Turkish-controlled areas set up new, separate governing bodies.

On July 4, 1974, Greek officers with the support of the military leaders ruling Greece overthrew Makarios. On July 20, Turkey sent troops to Cyprus to prevent what it saw as an attempt by Greece to unite Cyprus with Greece. Widespread fighting occurred between the Turks and Greek Cypriots, and the Turks captured large amounts of territory in northeastern Cyprus. A cease-fire was declared in August. Since then, the Turkish-controlled and Greek Cypriot areas of the island have been divided by a buffer zone called the "green line" or "Attila line." UN peacekeeping troops patrol the zone today.

Representatives of the Greek and Turkish Cypriots, and of Greece and Turkey, have met off and on since 1974 in an effort to reach new constitutional arrangements for all of Cyprus. But strong disagreements over control of the country remain. In 1975, Turkish Cypriot leaders declared the northeastern territory an *autonomous* (self-governing) region called the Turkish Federated State of Cyprus. In 1983, the Turkish Cypriots declared the territory an independent nation called the Turkish Republic of Northern Cyprus. H. Ibrahim Salih

See also Makarios III; Nicosia.

Cyrano de Bergerac, *SIHR uh NOH duh BUR juh RAK,* **Savinien de,** *sa vee NYAN duh* (1619-1655), was a French author and soldier. He was also known for his skill in swordfighting and for his long nose. Edmond Rostand's famous play *Cyrano de Bergerac* (1897) con-

tains a somewhat fanciful account of Cyrano's life.

Cyrano's most famous books are two science-fiction works published after his death. They are *The States and Empires of the Moon* (1657) and *The States and Empires of the Sun* (1662). A freethinker, Cyrano questioned traditional religious beliefs and the church's authority. He also said matter is made up of atoms.



Culver

Cyrano de Bergerac

Cyrano was born in Périgord. Twice wounded in battle, he left military life in 1642 to study science and literature in Paris. Robert B. Griffin

Cyril of Alexandria, *SIHR uhl,* **Saint** (378?-444), was the most outstanding Christian theologian of the early 400's. Cyril formulated what became known as the orthodox doctrine of the Incarnation. This doctrine deals with Jesus as both divine and human. For Cyril, salvation depended upon the proper understanding of how God made Himself human in the person of Jesus.

Cyril was born in Alexandria, Egypt. Little is known of his early life. In 412, Cyril succeeded his uncle, Archbishop Theophilus, in the *see* (bishop's seat) of Alexandria. Cyril attacked Jews, Christian heretics, and pagans with great vigor, and quarreled with the Roman urban prefect. He had the Jews expelled from Alexandria.

In 429, Cyril attacked Nestorius, bishop of Constantinople, for denying that the Virgin Mary was the mother of God. In 431, with the support of Pope Saint Celestine I, Cyril persuaded the Council of Ephesus to condemn Nestorius and to accept Cyril's interpretation of the doctrine of Jesus. His feast day is February 9. Richard R. Ring

Cyrillic alphabet. See **Alphabet** (Other systems of writing); **Russian language.**

Cyrus the Great, *SY ruhs* (? -530 B.C.), founded the Persian Empire about 550 B.C. He extended this empire to include most of southwestern Asia.

Cyrus was born into a noble Persian family, the Achaemenids. In 559 B.C., he became ruler of Anshan, a part of the Median Empire. About 550 B.C., Cyrus overthrew King Astyages of Media and made the Median Empire the center of what became the Persian Empire. He took control of western Asia Minor (now western Turkey) after defeating King Croesus of Lydia about 545 B.C. and then overcoming the Greek cities along the coast of Asia Minor. In 539 B.C., he conquered Babylonia and took control of much of the Middle East, including Palestine.

Cyrus respected local customs and religions in his empire. He freed the Jews from captivity in Babylonia and let them rebuild their temple at Jerusalem. He died in a battle in central Asia. Jack Martin Balcer

See also **Persia, Ancient** (The Achaemenid Empire).

Cyst, *sihst,* is a sac in the body that contains fluid and has no outside opening. Cysts of the skin occur more often than others. These usually form when the opening of an oil gland or *hair follicle* (baglike structure that surrounds a hair) becomes blocked. Some cysts form around a foreign substance that gets into the body. Others form around blood, after an injury. A cyst that forms in the salivary gland under the tongue is called a *ranula.* Cysts of internal organs are usually caused by abnormal development of the organ. Cysts may be removed by surgery. See also **Wen.** Paul R. Bergstresser

Cystic fibrosis, *SIHS tihk fy BROH sihs,* is a hereditary disease in which certain glands in the body secrete large amounts of abnormally thick mucus. Accumulation of mucus can block the ducts of these glands and eventually may block the passageways of organs into which the ducts empty. This accumulation of mucus may damage many organs, particularly the lungs, pancreas, and liver. Cystic fibrosis, often abbreviated CF, is also called *mucoviscidosis.*

The first symptoms of cystic fibrosis usually occur during infancy or early childhood. Infant deaths from CF are often caused by a blockage in the intestines. Patients who survive early infancy develop breathing difficulties because the thick mucus blocks their air passages. Many patients also suffer from frequent lung infections. Lung problems are the most common cause of death of CF patients. Cystic fibrosis patients may fail to digest their food completely because plugs of mucus may prevent the pancreas from secreting digestive enzymes. Physicians can diagnose CF by testing the patient's perspiration. People with the disease have much sodium chloride (salt) in their perspiration.

In 1989, researchers identified a gene called *cystic fibrosis transmembrane conductance regulator* (CFTR), which is responsible for CF. This gene, on a pair of chromosomes designated *chromosome 7,* normally allows chloride to pass through the cells that line many organs. A person who inherits a pair of abnormal CFTR genes cannot effectively absorb chloride into his or her cells and has CF. But scientists do not fully understand how the impaired chloride movement in cells causes the abnormal secretion of mucus found in CF patients.

People who carry one normal and one abnormal CFTR gene do not have the disease themselves. They are called *carriers.* Couples who plan to have children can be tested to see if they are carriers of the abnormal gene. A child of two carriers has a 1 in 4 chance of inheriting cystic fibrosis.

Cystic fibrosis cannot yet be cured. Doctors use antibiotics to fight the lung infections. Digestion can be improved by special diets and by pills that contain the missing enzymes. A drug called *DNase* is used for treatment of CF. The drug is genetically engineered from an enzyme that occurs naturally in the human body. DNase breaks down the substances that thicken mucus in the airways. Gentle pounding on the chest helps loosen the mucus from clogged airways so that the patient can cough it up.

In addition, scientists continue to try to develop techniques using *gene therapy* for patients with cystic fibrosis. Gene therapy involves replacing the abnormal genes with copies of normal genes. Michael G. Levitzky

See also **Races, Human** (Susceptibility to genetic disease).

Cytoplasm. See **Cell** (Inside a living cell); **Protoplasm.**

Czar, *zahr,* also spelled *tsar,* was the title used by the emperors of Russia. *Czar* comes from *Caesar,* the name used by the emperors of Rome. The first Russian ruler to be crowned czar was Ivan the Terrible, in 1547. The last one was Nicholas II (1868-1918). See also **Caesar; Kaiser.**



Travelpix from FPG

Prague, the capital and largest city of the Czech Republic, is one of the most beautiful cities in central Europe. The Charles Bridge, *shown here,* is a major tourist attraction.

Czech Republic

Czech Republic is a country in central Europe. It is bordered by Poland to the north, Slovakia to the east, Austria to the south, and Germany to the west. Prague is the capital and largest city.

Most of the people in the Czech Republic belong to a Slavic group called *Czechs.* Two regions—Bohemia in the west and Moravia in the east—make up most of the republic. The country also includes a small part of a region called Silesia, which extends from the northern section of the Czech Republic into Poland.

The area that is now the Czech Republic has been an industrial center since the 1800's. In 1918, at the end of World War I, the area became part of the newly created nation of Czechoslovakia. From 1948 until 1989, when Communists ruled Czechoslovakia, the nation's people had one of the highest standards of living in Communist central and eastern Europe. However, their prosperity declined in the 1980's, and dissatisfaction with the Communist government grew. In 1989, after mass protests, the country's top Communist leaders resigned. Non-Communists took over the Czechoslovak government.

Soon after the Communists left office, tensions began to build between Czechoslovakia's two main ethnic groups, the Czechs and the Slovaks. In mid-1992, Czech and Slovak leaders decided to split Czechoslovakia into two nations, one for Czechs and one for Slovaks. On Jan. 1, 1993, the Czech Republic and Slovakia were formed to replace Czechoslovakia.

This article deals with the area that is now the Czech Republic from its early history to the present. For more information on Czechoslovakia, see **Czechoslovakia.**

Sharon L. Wolchik, the contributor of this article, is Professor of Political Science and International Affairs at George Washington University and author of Czechoslovakia in Transition.

Government

National government. The Czech Republic is a parliamentary democracy. A two-house Parliament makes the country's laws. The 81 members of the smaller house, called the Senate, serve six-year terms. Voters

Facts in brief

Capital: Prague.
Official language: Czech.
Official name: Česká Republika (Czech Republic).
Area: 30,450 mi² (78,864 km²). *Greatest distances*—east-west, 305 mi (491 km); north-south, 175 mi (282 km).
Elevation: *Highest*—Sněžka, 5,256 ft (1,602 m) above sea level. *Lowest*—377 ft (115 m) along the Elbe River near the German border.
Population: *Estimated 2002 population*—10,215,000; density, 335 per mi² (130 per km²); distribution, 77 percent urban, 23 percent rural. *1991 census*—10,302,215.
Chief products: *Agriculture*—barley, cattle, corn, hogs, hops, oats, potatoes, poultry, rapeseed, rye, sheep, sugar beets, wheat. *Manufacturing*—footwear, glass, iron and steel, textiles. *Mining*—coal.
National anthem: "Kde domov můj?" ("Where Is My Home?")
Money: *Basic unit*—koruna. One hundred haler equal one koruna.

elect one-third of the senators every two years. The 200 members of the larger house, called the Chamber of Deputies, are elected to four-year terms. The Parliament elects a president, who serves as head of state. The president appoints a prime minister, who heads the government and oversees its day-to-day operations. The prime minister names a cabinet to help carry out the executive functions of government.

Local government. The Czech Republic is divided into 14 regions. The nation's largest city, Prague, forms one of these regions. Each region is governed by an elected assembly. Cities, towns, and villages also have their own local governments.

Politics. The Czech Republic has many political parties. The leading parties are the Civic Democratic Party, which is a moderately conservative party, and the Czech Social Democratic Party, whose members are moderately liberal. Other political parties include the Christian Democratic Union-Czech People's Party, the Communist Party, and the Freedom Union. All Czech citizens 18 years of age and older may vote.

Courts. The Supreme Court is the Czech Republic's highest court. The Czech Republic also has a constitutional court and high, regional, and district courts.

Armed forces. The Czech Republic has an army with about 25,000 members and an air force with about 15,000 members. Men are required to serve for one year in the armed forces after reaching the age of 18. Women serve in the military on a voluntary basis.

People

Population. About 80 percent of the people of the Czech Republic are Czechs, and about 15 percent are Moravians. Slovaks make up about 3 percent of the population. Small numbers of Germans, Gypsies, Hungarians, and Poles also live in the Czech Republic.

Before World War II (1939-1945), Czechoslovakia had a large Jewish population. But almost all the Jews were killed by Nazis during the war. Today, between 15,000 and 18,000 Jews live in the Czech Republic. Most of the Jews make their homes in Prague, which has a well-preserved Jewish synagogue and cemetery.

Ancestry. The Czechs are descendants of Slavic tribes who settled in the region by about A.D. 500. Bohemia gets its name from the Boii, a Celtic tribe that probably lived in the region in about the 400's B.C. There have been large German settlements in what is now the Czech Republic for much of the region's history.

Language. The official language of the Czech Republic is Czech. Moravians speak a form of Czech that is slightly different from that spoken in Bohemia. Slovaks speak Slovak, a language closely related to Czech. Gypsies speak Romany, which belongs to the Indo-Iranian group of languages. Other minority groups speak their own languages at home but generally also speak Czech.

Way of life

City life. Most of the people in the Czech Republic live in towns and cities. Prague, the country's capital, is also its largest city.

The Czech Republic has a severe housing shortage. Most of the people in urban areas live in apartment buildings. Many of these buildings are poor quality high-rises that were built during the Communist era.

Air pollution is a health threat in the Czech Republic, especially in the cities. Alcoholism, crime, and drug abuse are also serious problems.

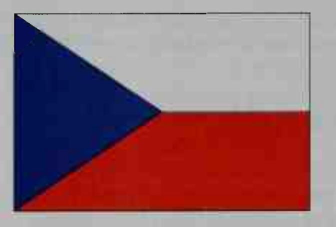
The Czech government has worked hard to move from a Communist state-controlled economy to one based on private enterprise. Despite disruptions caused by the shift, the people of the Czech Republic have maintained one of the highest standards of living in post-Communist central and eastern Europe. Most households have automobiles, refrigerators, televisions, and washing machines. Many city families have country cottages.

Rural life. People in rural areas usually work in agriculture or travel to cities or nearby factories to work. Rural families often live in single-family homes.

Food and drink. The Czech diet is close to that of Germany. Pork is a popular dish, as are sliced, boiled dumplings and pickled cabbage. Carp with potato salad is a traditional Christmas menu. Apple strudel is a favorite dessert.

World-famous Czech beer is the main alcoholic beverage consumed in the Czech Republic. Plzeň's breweries invented a type of pale beer that became known as Pilsner. Several fine wines are made in Moravia.

Recreation. Favorite forms of recreation in the Czech Republic include attending and playing in soccer matches and other sporting events, and watching mo-





Symbols of the Czech Republic include a flag adopted in 1993. It is the same flag that Czechoslovakia used. The coat of arms features a white lion with a double tail on a red field. The Holy Roman emperor granted it to Bohemia in the 1100's.



WORLD BOOK map

The Czech Republic is in central Europe. It borders four countries including Slovakia, its former partner in Czechoslovakia.

tion pictures and television. Many people gather in pubs to chat, play games, and drink. Outdoor activities, including gardening, hiking, and such winter sports as skiing and skating, are also popular.

Religion. The Communist rulers of Czechoslovakia tried to keep people from practicing religion. In 1990, Czechoslovakia's new government granted the people full religious freedom. About 40 percent of Czechs still practice no religion. Another 40 percent of the people are Roman Catholics. Other active churches include the Orthodox Church, the Czechoslovak Hussite Church, and the Czech Brethren. The Jewish population is working to revive Jewish culture and customs.

Education. Czech law requires children to attend nine years of elementary school. A student may then attend a vocational or technical secondary school, a teacher training institute, or a general education school.

Charles University in Prague is one of the oldest universities in Europe. It was founded in 1348. Other universities are in Brno, Olomouc, and Opava.

The arts. The composers Antonín Dvořák and Bedřich Smetana, who wrote their major works in the late 1800's, are considered the founders of the Czech national school of music. Composer Leoš Janáček created operas in the early 1900's that show his interest in Moravian folk music. Today, country music, jazz, and rock are also popular in the Czech Republic.

The first major works of literature in Czech were written in the 1300's. Czech literature flowered during an awakening of national identity that began in the late 1700's and continued into the early 1900's. Outstanding authors from the later period include Karel Čapek; Jaroslav Hašek; and Franz Kafka, who wrote in German.

Czechoslovakia's Communist government attempted to limit artistic expression. However, many Czech artists, filmmakers, and writers resisted political control. Miloš Forman, Jiří Menzel, and other Czech *New Wave* filmmakers achieved worldwide acclaim during the 1960's for motion pictures that criticized social and political conditions. Many Czech writers became known outside of Czechoslovakia for their works. These writers include the novelist Milan Kundera; the playwright Václav Havel, who later became president of Czechoslovakia and of the Czech Republic; and the poet Jaroslav Seifert, who won the Nobel Prize for literature in 1984. The non-Communist government removed restrictions on art in 1990.

Land and climate

The Czech Republic consists of five main geographic regions: (1) the Bohemian Mountains; (2) the Sudeten Mountains; (3) the Bohemian Basin; (4) the Bohemian-Moravian Highlands; and (5) the Moravian Lowlands.

The Bohemian Mountains are a series of mountain ranges in the western part of the Czech Republic. These ranges include the Ore Mountains in the northwest and the Bohemian Forest in the west and southwest. This region, which rises more than 2,500 feet (762 meters) above sea level, is known for its ski slopes and *spas* (health resorts). Many people visit the spas at Karlovy Vary (also called Karlsbad) and Mariánské Lázně (also called Marienbad) to drink waters from the mineral springs there or to bathe in them. Coal mining in the Ore Mountains and industrial pollution have damaged the region's environment. The Bohemian Forest is an important source of lumber and wood products.

The Sudeten Mountains form much of the Czech Republic's northern border. The *Krkonoše* (Giant) Mountains of the Sudeten system have one of the country's largest nature preserves. But acid rain and other kinds of pollution threaten the animal and plant life of these mountains.

The Bohemian Basin is located in north-central Bohemia. This region of low plains and rolling hills has much fertile farmland. Prague and Hradec Králové are among the region's industrial centers. Several major rivers, including the Elbe, Ohře, and Vltava, flow through the basin.

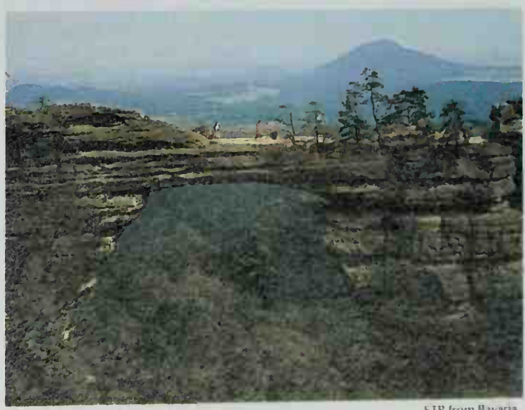
The Bohemian-Moravian Highlands cover much of the central part of the Czech Republic. High plains, plateaus, and low hills make up this largely agricultural region. Plzeň, the largest city in the area, is a major manufacturing center noted for automaking and beer brewing. The Sázava, the Vltava, and several smaller rivers drain the highlands.

The Moravian Lowlands occupy the southeastern part of the country. Farmers grow a variety of crops in the fertile valley of the Morava River. Many farmers also raise cattle there. The city of Ostrava is an industrial and mining center. Important coal fields lie nearby. The Morava and Oder are the chief rivers of the lowlands.

Climate. The Czech Republic has warm summers and cold winters. Temperatures vary greatly by elevation. They range from an average of 23 °F (−5 °C) in winter to 68 °F (20 °C) in summer. Annual *precipitation* (rain, melted snow, and other forms of moisture) ranges from 18 to 41 inches (45 to 103 centimeters).

Economy

After the Communists came to power in Czechoslovakia in 1948, they began managing all aspects of the economy. They put all factories and almost all farms under state control. They changed the economy's focus from light industry, such as glass and textiles, to heavy industry, such as machinery and steel. The economy thrived until the 1960's, when poor planning, labor shortages, and other problems caused it to decline. After the Communist government resigned in 1989,



STR from Bavaria

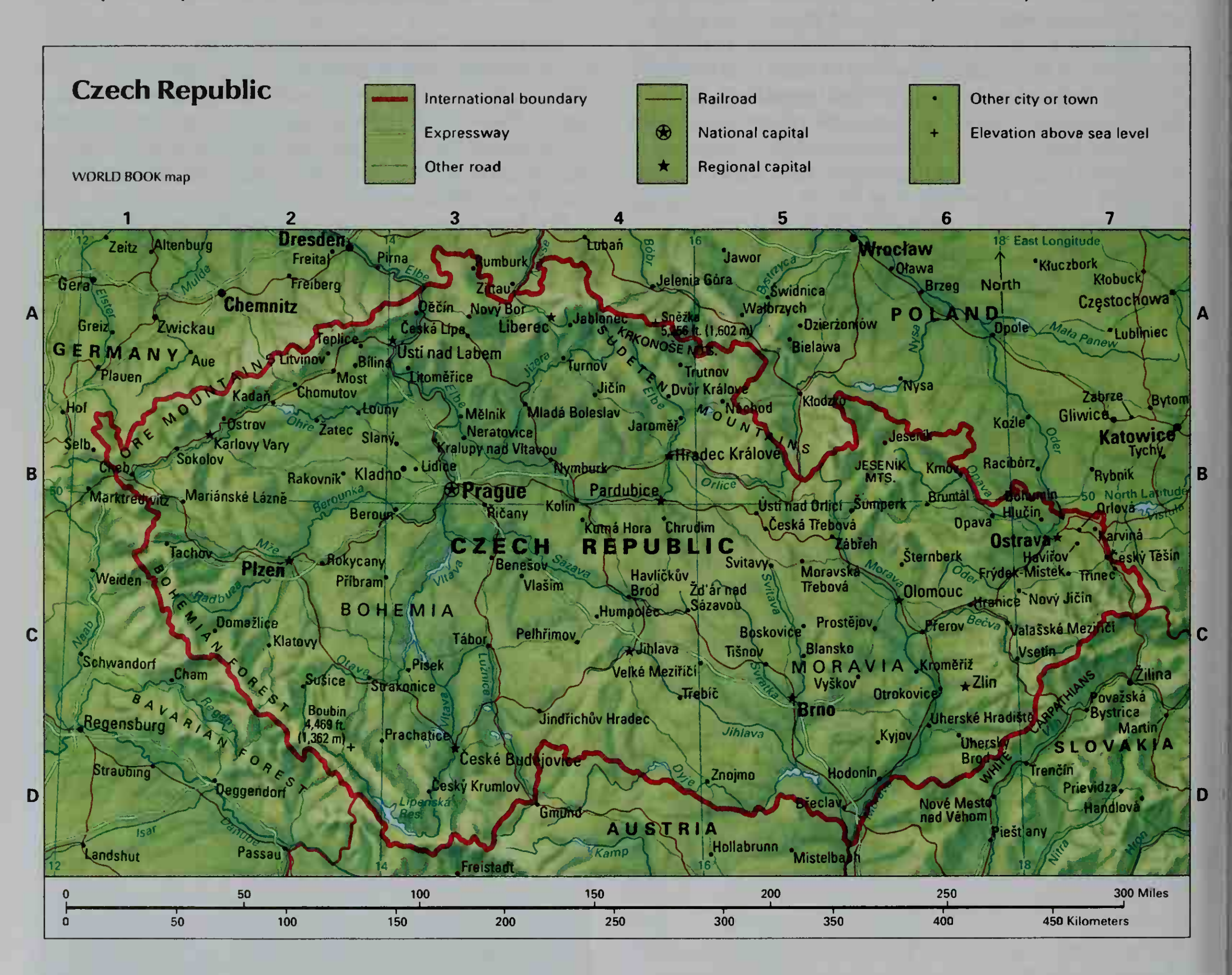
The Sudeten Mountains form most of the northern border of the Czech Republic. The natural beauty of the region draws many hikers, mountain climbers, and other outdoor enthusiasts.

Czechoslovakia's new leaders moved quickly to create a free enterprise economy, in which businesses could operate without extensive government control. Many new businesses were established, especially in retail trade and other service industries.

Service industries. About 50 percent of the workers of the Czech Republic hold jobs in service industries. During the Communist period, the service sector was largely undeveloped. But it is growing rapidly today. There are many new, privately owned insurance and real estate firms, medical and other professional services, repair shops, and retail stores. Hotels and travel agencies have expanded to meet a large increase in tourism since the late 1980's.

Manufacturing and mining. Manufacturing employs about 40 percent of the labor force of the Czech Republic. Although heavy industry is still important today, light industries such as footwear, glass, and textiles are reemerging as important producers for export. The main manufacturing centers are Brno, Hradec Králové, Ostrava, Plzeň, Prague, and Ústí nad Labem.

The Czech Republic has large deposits of brown coal. The Ore Mountains contain large deposits of uranium and small amounts of antimony, mercury, and tin.



Czech Republic map index

Cities and towns

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Blansko ....19,962 ..C 5
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Bohemian Forest ......C 1
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Sudeten Mountains ....A 4
Svitava (river) ....C 5
Svratka (river) ....C 5
Vltava (river) ....C 3

Sources: 1990 official estimates for largest cities; 1985 official estimates.

Agriculture employs about 10 percent of the workers of the Czech Republic. About 40 percent of the country's land is suitable for farming. Major crops are barley, corn, fruits, hops, oats, potatoes and other vegetables, rapeseed, rye, sugar beets, and wheat. Farmers also raise cattle, hogs, poultry, and sheep.

When Communists ruled Czechoslovakia, almost all the farms were either state farms or *collectives.* State farmworkers earned a salary from the government, while collective farmworkers received a share of the farm's profits, some of its products, and a small wage. Legislation was passed in 1991 that allowed farmland to be returned to private farmers. By 2000, about 80 percent of the farmland was privately owned.

Trade. The Czech Republic's main trading partners are Austria, France, Germany, Hungary, Italy, Poland, Russia, Slovakia, and the United States. Chief exports include automobiles, coal, footwear, iron and steel, and machinery. The country depends heavily on imports of natural gas and petroleum. Other major imports include iron ore, other ores, and automobiles.

Transportation and communication. The Czech Republic has a well-developed system of roads and railroads. There are about 35,000 miles (56,000 kilometers) of highways and 5,900 miles (9,500 kilometers) of railroads. Prague has a subway system and an international airport.

There are about 30 daily newspapers and some 1,800 other journals, newspapers, and magazines in the Czech Republic. Radio and television stations operate under both private and state ownership. Foreign news broadcasts, such as Cable News Network, are also available.

History

Early days. Celtic tribes probably lived in what is now the Czech Republic in about the 400's B.C. Germanic tribes arrived about 10 B.C. Various Slavic tribes, including the ancestors of the present-day Czechs, settled in the region by about A.D. 500. The Slavs were conquered by the Avars in the 500's. The Slavs drove the Avars from the region in the 600's. Several of the Slavic tribes united to create their own state in the 800's. The state formed the core of the Great Moravian Empire, which eventually included Bohemia, southern Poland, Slovakia, and parts of western Hungary. Hungarian tribes conquered the Great Moravian Empire in 907.

The rise of Bohemia began during the 900's. The Přemyslid dynasty ruled Bohemia for almost 400 years. Under its rule, Bohemia expanded its territory and came under the protection of the Holy Roman Empire, a German-based empire that also included Austria and parts of Belgium, Italy, and the Netherlands. In 1212, Holy Roman Emperor Frederick II made Bohemia a semi-independent kingdom within the empire. Many German craftworkers and merchants settled in Bohemia in the 1200's, contributing to the region's prosperity.

Bohemia's political and economic power continued to grow in the 1300's. Prague flourished under Charles IV, who became king of Bohemia in 1346 and ruled as Holy Roman emperor from 1347. In 1348, Charles founded Charles University, the first university in central Europe, in Prague. He also brought foreign artists to Prague to make the city a major European cultural center.

The death of a priest named John Hus in 1415 triggered a series of religious wars in Bohemia. Hus led a movement to reform the Roman Catholic Church and was burned at the stake as a heretic. The wars ended in 1436 with a compromise. In 1458, Hus supporters elected Jiří of Poděbrady, a Protestant, king of Bohemia. Jiří thus became the first Protestant king in Europe. In the late 1400's, most of the Czech nobility became Protestants, and the power of the nobles increased.

Habsburg rule. In 1526, the Austrian Habsburgs (or Hapsburgs), a Catholic family, began ruling Bohemia. Bohemia remained partially independent, though the nobles lost some power. In 1618, a group of Czech Protestant nobles revolted against the Habsburgs. This revolt touched off the Thirty Years' War, a series of wars that spread through Europe.

In 1620, the Habsburg armies defeated the nobles in the Battle of White Mountain. Almost all the nobles were killed or forced into exile. Bohemia then lost most of its self-governing powers. The Habsburgs made the people convert to Catholicism. They also forced most Czechs to give up their own language and culture and adopt German.

German culture dominated Bohemia until the late 1700's. At about this time, industries began to develop in Bohemia and Moravia, and many Czech peasants moved to cities. Czech writers and other intellectuals worked to create a greater sense of national identity among Czechs. By the mid-1800's, a movement for self-government had gathered strength. But Austria continued to rule Bohemia and Moravia. In 1867, Austria and Hungary formed a monarchy called Austria-Hungary.

The creation of Czechoslovakia. During World War I (1914-1918), Tomáš G. Masaryk and other Czech leaders sought support abroad for their idea of an independent state made up of Czechs and Slovaks. At the end of the war, Austria-Hungary collapsed, and Czechoslovakia was created from a part of it. The Czechoslovak Constitution established a democratic republic.

Masaryk served as president of Czechoslovakia from 1918 until 1935, when Eduard Beneš succeeded him. The 1920's and early 1930's were generally a period of political stability and prosperity in Czechoslovakia. However, the Czech-dominated government was less successful in dealing with the country's minority groups. Many Slovaks began calling for broader powers of self-government. The *Sudeten Germans*—Germans living in the Sudetenland, the border regions of western Czechoslovakia—were also dissatisfied with Czech rule.

The Munich Agreement. In 1938, German dictator Adolf Hitler used the dissatisfaction of the Sudeten Germans to pressure Czechoslovakia to give the Sudetenland to Germany. He threatened to declare war on Czechoslovakia if his demand was not met. In an attempt to avoid war, British and French leaders gave in to Hitler's demand. They signed the famous Munich Agreement forcing Czechoslovakia to turn over the Sudetenland to Germany. Later that year, Poland and Hungary claimed parts of Czechoslovakia. In March 1939, a few months before World War II broke out, Germany seized the rest of Czechoslovakia. Slovakia became a separate state under German control, and German troops occupied Bohemia and Moravia. Beneš, who had resigned as president in 1938, established a government-in-exile in London.

The people of Bohemia and Moravia suffered greatly under German occupation. Nazis killed almost all the Jewish population. By 1945, Soviet troops had freed most of Czechoslovakia from the Germans. After World War II ended in 1945, the government-in-exile returned. Sudetenland was returned to Czechoslovakia, and over 2 million Germans were expelled from the region.

Communist rule. Beneš formed a coalition government to lead postwar Czechoslovakia. Leaders of the Communist Party held many important positions in the new government. In national elections in 1946, the Communists won more votes than any other party. In 1948, they caused a crisis that led to the resignation of non-Communist government ministers. The Communists then formed a government dominated by Communists. Beneš soon resigned and was replaced by Communist Party chairman Klement Gottwald.

Czechoslovakia's Communist leaders copied the Soviet model of Communist rule. The Communist Party became the only powerful political party. The government controlled the planning and production of all important goods. It took over nearly all the country's land and forced most farmers to join state farms or collectives. Censorship became widespread. The power of the secret police grew, and Czechoslovakia became one of the Soviet Union's most loyal allies.

The 1960's. During the 1960's, economic performance in Czechoslovakia dropped. In addition, many Slovaks wanted greater recognition of Slovak rights. In 1968, Alexander Dubček became head of the Communist Party. Under Dubček, the government introduced a program of liberal reforms known as the Prague Spring or "socialism with a human face." The press was granted greater freedom, and citizens were given a limited role in politics. But leaders of the Soviet Union and other European Communist nations feared that Dubček's programs would weaken Communist control in Czechoslovakia. They also feared that people in other Communist countries would demand similar reforms. As a result, troops from the Soviet Union, Bulgaria, East Germany, Hungary, and Poland invaded Czechoslovakia in August 1968. Gustáv Husák replaced Dubček as head of the Communist Party in April 1969 and reversed most of the reforms. A small number of *dissidents* (political protesters) continued to oppose the government.

The Velvet Revolution. During the late 1980's, the standard of living in Czechoslovakia fell. Support for the Communist system also declined. The dissident movement grew, inspired by the democratic reforms that were taking place in the Soviet Union under Mikhail S. Gorbachev. In November 1989, large numbers of Czechs and Slovaks gathered in the streets of Prague to call for an end to Communist rule. Less than a month after the protests began, the Communist government resigned. Non-Communist leaders gained control of the government. The Federal Assembly elected Václav Havel, a non-Communist playwright, to succeed Husák as president. The end of Communist rule in Czechoslovakia occurred so smoothly and peacefully that it became known as the *Velvet Revolution.*

In free elections held in June 1990, Civic Forum—the Czech party that had emerged in 1989 to lead the Velvet Revolution—and its Slovak ally, Public Against Violence, won a majority of seats in the Federal Assembly. The Assembly reelected Havel president in July 1990.

Czechoslovakia's new leaders restored such basic civil liberties as freedom of religion, speech, and the press. New laws were passed to change the legal system, restore property rights, and establish a free enterprise economy. The leaders also reestablished friendly relations with Western nations, including the United States.

The breakup of Czechoslovakia. After the non-Communist government took office, Czechs and Slovaks began to disagree over political and economic issues. The disagreements blocked the adoption of a new constitution and slowed economic reform. In mid-1992, Czech and Slovak leaders began to discuss splitting the country into two separate nations. Havel resigned, saying that he did not want to preside over the breakup of Czechoslovakia.

On Jan. 1, 1993, the Czech Republic and Slovakia were created to replace Czechoslovakia. Later in January, the Czech legislature elected Havel president of the new Czech Republic.

Recent developments. In 1997, the legislature elected Havel to a second term. In 1999, the Czech Republic joined the North Atlantic Treaty Organization (NATO), a military alliance of Western nations. Sharon L. Wolchik

Related articles in *World Book* include:

Biographies

Beneš, Eduard
Čapek, Karel
Comenius, John Amos
Dvořák, Antonín
Havel, Václav
Hus, John
Janáček, Leoš
Kafka, Franz
Masaryk (family)
Smetana, Bedřich

Cities

Brno
Karlovy Vary
Ostrava
Prague

History

Austria (History)
Czechoslovakia
Habsburg, House of
Munich Agreement
Thirty Years' War
Warsaw Pact
World War II (The failure of appeasement)

Other related articles

Bohemia
Elbe River
Moravia
Ruthenia
Silesia
Slovakia
Sudetenland

Outline

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VI. History

Questions

What event in Bohemia touched off the Thirty Years' War?
What industries were stressed in Czechoslovakia during the Communist era?
What beverage is the Czech Republic famous for?
Which Czech poet won the Nobel Prize for literature in 1984?
Who were the first and last presidents of Czechoslovakia?
What changes did Czechoslovakia's new leaders make after they took office in 1989?
When and how did Communist rule of Czechoslovakia end?
Who were the founders of the Czech national school of music?
Why did troops invade Czechoslovakia in August 1968?
What Czech Republic region has especially fertile soil?

Czechoslovakia was a country in central Europe from 1918 until 1992. On Dec. 31, 1992, Czechoslovakia ceased to exist, and the Czech Republic and Slovakia were formed in its place.

Czechoslovakia was home to two closely related Slavic peoples, the Czechs and the Slovaks. Most of the Czechs lived in the western part of the country, in the regions of Bohemia and Moravia. The Slovaks lived primarily in Slovakia, an area in the east.

In 1948, Communists began ruling Czechoslovakia. In 1989, hundreds of thousands of citizens participated in demonstrations calling for an end to Communist rule. In response, the Communist government resigned and a non-Communist government came to power.

Czechs and Slovaks disagreed over how to reform the country's government and economy. In mid-1992, Czech and Slovak leaders decided to break Czechoslovakia into two separate nations. On Jan. 1, 1993, the Czechs formed the Czech Republic and the Slovaks formed Slovakia to replace Czechoslovakia.

Early history. Celtic and Germanic tribes lived in what became Czechoslovakia more than 2,000 years ago. Slavic tribes settled in the region by about A.D. 500. Several of the tribes united to form a state in the 800's. The state became the core of the Great Moravian Empire, which soon covered much of central Europe. Hungarian tribes conquered the empire in 907. Hungarians then ruled Slovakia for about the next 1,000 years.

In 1212, Bohemia became a semi-independent kingdom within the Holy Roman Empire, a German-based empire in western and central Europe. In 1526, the Austrian Habsburgs (or Hapsburgs) began ruling Bohemia. In time, Bohemia lost most of its self-governing powers. In the late 1700's, Czech intellectuals worked to create a greater sense of national identity among Czechs. By the mid-1800's, a movement for self-government had gathered strength. A similar movement grew in Slovakia. But Hungarian rulers put down the Slovak movement. In 1867, Austria and Hungary formed a monarchy called Austria-Hungary.

The formation of Czechoslovakia. During World War I (1914-1918), two leading Czech nationalists—Eduard Beneš and Tomáš G. Masaryk—worked to gain foreign support for the idea of an independent nation made up of Czechs and Slovaks. At the end of World War I in 1918, Austria-Hungary collapsed, and Czechoslovakia was created from part of it. The Czechoslovak Constitution established the country as a democratic republic. Masaryk served as president from 1918 until 1935, when Beneš succeeded him. In 1919, Ruthenia, a region east of Slovakia, became part of Czechoslovakia.

Although Czechs made up less than 50 percent of the population of Czechoslovakia, they dominated the economy and government. During the 1920's and 1930's, many Slovaks grew resentful of Czech control. The *Sudeten Germans* (Germans who lived in the Sudetenland, the border regions of western Czechoslovakia) also became dissatisfied with Czech dominance.

The Munich Agreement. German dictator Adolf Hitler encouraged the Sudeten Germans to demand self-rule. He threatened war with Czechoslovakia if the demand was not met. In 1938, the leaders of the United Kingdom and France agreed to Hitler's demand and signed the Munich Agreement, a pact that forced Czechoslovakia to give the Sudetenland to Germany. Later that year, Hungary and Poland claimed other parts of Czechoslovakia. In March 1939, a few months before World War II broke out, Germany seized the rest of Czechoslovakia. Slovakia became a separate republic under German control. Hitler made Bohemia and Moravia a German protectorate.

German occupation during the war brought widespread suffering to Czechoslovakia. Over 250,000 people, including almost all the country's Jews, were killed.

Eduard Beneš, who had resigned as president in 1938, formed a government-in-exile in London during the war. He cooperated with both Western powers and the Soviet Union. In 1943, he signed a treaty of friendship and cooperation with the Soviet government. By 1945, the Soviet army had freed most of Czechoslovakia from the Germans. United States troops liberated parts of Bohemia. After World War II ended in 1945, the government-in-exile returned, and all foreign troops were withdrawn from Czechoslovakia. The same year, Czechoslovakia gave Ruthenia to the Soviet Union, and the Sudetenland was returned to Czechoslovakia. Over 2 million Germans were expelled from the Sudetenland.

Communist rule. Beneš formed a coalition government to lead postwar Czechoslovakia. Communists held many important positions in the new government. With popular support, the government put many of the country's major industries under state control. It also forced hundreds of thousands of Germans and Hungarians living in Czechoslovakia to leave.



WORLD BOOK map

Czechoslovakia was a country in central Europe that existed from 1918 until 1992. It consisted of three main regions—Bohemia, Moravia, and Slovakia. Germany took over the Sudetenland in 1938 and seized the rest of Czechoslovakia in 1939.

In national elections in 1946, the Communist Party received more votes than any other party. The Communist Party chairman, Klement Gottwald, became prime minister of Czechoslovakia. In February 1948, the Communists caused a crisis that led to the resignation of non-Communist government ministers. The Communists then formed a government dominated by Communists. Beneš resigned a few months later, and Gottwald succeeded him.

Czechoslovakia's Communist leaders copied the Soviet model of political organization and economic development. The Communist Party became the only powerful political party. The government managed all aspects of the economy. Farmers were forced to join either state farms or *collectives.* The government owned and operated state farms. On collective farms, farmworkers jointly owned the farm equipment and property.

Gottwald remained president of Czechoslovakia until 1953, when Antonín Zápotocký succeeded him. Antonín Novotný became president in 1957.

The 1960's. During the early 1960's, Czechoslovakia's agricultural and industrial production dropped, and there were shortages of food and other goods. Even members of the Communist Party criticized the government's inability to reverse the economic decline. At the same time, the country's intellectuals called for more freedom of expression, and many Slovaks renewed their efforts to gain recognition for Slovak rights. In 1968, the Communists removed Antonín Novotný as party leader. Alexander Dubček, a Slovak, became the party leader, and Ludvík Svoboda became the country's president.

Under Dubček, the government introduced a program of liberal reforms. These reforms included more freedom of the press and increased contacts with non-Communist countries. Dubček won popularity among Czechoslovakia's people for the reforms, known as the "Prague spring." But leaders of the Soviet Union and other European Communist nations feared that Dubček's program would weaken the party's control in Czechoslovakia. They also feared that people in other Communist countries would demand similar reforms. The reform movement ended when troops from the Soviet Union, Bulgaria, East Germany, Hungary, and Poland invaded Czechoslovakia in August 1968. The Soviet troops remained, but the other troops withdrew by late 1968.

In April 1969, the Czechoslovak Communist Party replaced Dubček with Gustáv Husák, another Slovak Communist. Thousands of people who had been active in the reform movement either resigned or were removed from the party. In 1975, Husák succeeded Svoboda as president and also continued to serve as Communist Party leader. Under Husák, Czechoslovakia remained a tightly controlled Communist state and a loyal ally of the Soviet Union.

The Velvet Revolution. In 1987, Husák resigned as Czechoslovakia's Communist Party leader. He remained president. Miloš Jakeš succeeded Husák as party leader. In November 1989, hundreds of thousands of people gathered in the streets of Prague to demand changes in the government and greater political, economic, and civil freedoms. The demonstrations were followed by general strikes and demonstrations by people across the country. In response to the protests, Communist Party leader Jakeš resigned and Karel Urbánek replaced him. In addition, Czechoslovakia's Communist-controlled Federal Assembly voted to end Communism's leading role in the Czechoslovak government and society.

In December, Marián Calfa, a liberal Communist, became prime minister and later left the Communist Party. Non-Communists gained control of most key Cabinet ministries. Husák then resigned under pressure. The Federal Assembly elected Václav Havel, a non-Communist playwright, to succeed Husák. The end of Communist rule was so smooth and peaceful that it became known as the *Velvet Revolution.*

The new government worked to increase free enterprise in Czechoslovakia. It restored such civil liberties as freedom of religion, speech, and the press. It also called for free elections, which were held in June 1990. In the elections, the Civic Forum—the Czech party that had emerged in November 1989 to lead the Velvet Revolution—and its Slovak ally, Public Against Violence, won a majority of seats in the Federal Assembly. The Assembly reelected Havel president in July 1990. The Soviet Union withdrew its troops from Czechoslovakia in June 1991, six months before it broke apart.

In 1992, Czechoslovakia's government took a large step toward establishing an economy based on free enterprise. It began to sell shares of stock in companies it had owned. As a result, more than 1,000 companies became privately owned. In addition, hundreds of thousands of new privately owned businesses were established.

However, the move toward a free-enterprise economy caused far more unemployment in Slovakia than in the Czech areas. Tensions between the Czechs and Slovaks prevented the adoption of a new constitution and slowed economic reform. Although many Czechs and Slovaks wanted to remain united, the prime ministers of the Czech Republic and Slovakia began negotiating the breakup of Czechoslovakia in June 1992. Havel resigned, saying he did not want to preside over the breakup of his country. On Jan. 1, 1993, the independent nations of the Czech Republic and Slovakia were created to replace Czechoslovakia. Sharon L. Wolchik

Related articles. See **Czech Republic** and **Slovakia** and their lists of *Related articles.* See also:

Beneš, Eduard	Masaryk (family)
Havel, Václav	Munich Agreement
Heydrich, Reinhard	Sudetenland
Lidice	Warsaw Pact

Czerny, *CHEHR nee,* **Karl** (1791-1857), was an Austrian composer, teacher, and pianist. He composed more than 1,000 works in a wide variety of instrumental and vocal forms. He also arranged many works by other composers for piano. His reputation rests largely on his many instructional compositions for piano, called *études.*

Czerny was born in Vienna. He was a friend of the German composer Ludwig van Beethoven and studied with him from 1800 to 1803. Early in his career, Czerny gave frequent piano recitals. But he gradually gave up public performing and concentrated on teaching and composing. Czerny became a highly successful teacher of many pupils. Daniel T. Politoske

Czolgosz, Leon. See **McKinley, William** (Assassination).

